PB-223 637

MILITARY AIRCRAFT AND AIRPORT NOISE AND OPPORTUNITIES FOR REDUCTION WITHOUT INHIBITION OF MILITARY MISSIONS

Sidney J. Nethery

Environmental Protection Agency
Washington, D. C.

27 July 1973

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 223 637

NTID 73.7

MILITARY AIRCRAFT AND AIRPORT NOISE AND OPPORTUNITIES FOR REDUCTION WITHOUT INHIBITION OF MILITARY MISSIONS

ENVIRONMENTAL PROTECTION AGENCY
AIRCRAFT/AIRPORT NOISE STUDY REPORT

27 JULY 1973

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

MILITARY AIRCRAFT AND AIRPORT NOISE AND OPPORTUNITIES FOR REDUCTION WITHOUT INHIBITION OF MILITARY MISSIONS

ENVIRONMENTAL PROTECTION AGENCY
AIRCRAFT/AIRPORT NOISE STUDY REPORT

27 JULY 1973

SIDNEY J. NETHERY, TASK GROUP CHAIRMAN

This document is the result of an extensive task force effort to gather all available data pertinent to the subject discussed herein. It represents the interpretation of such data by the task group chairman responsible for this specific report. It does not necessarily reflect the official views of EPA and does not constitute a standard, specification, or regulation.

BIBLIOGRAPHIC DATA SHEET

1. Report No. NTID 73.7

2.

3. Recipient's Accession No. PB-223 637

4. Title and Subtitle MILITARY AIRCRAFT AND AIRPORT NOISE AND OPPORTUNITIES FOR REDUCTION WITHOUT INHIBITION OF MILITARY MISSIONS. Environmental Protection Agency Aircraft/Airport Noise Study Report

5. Report Date 27 July 1973

6.

7. Author(s) Task Group 6, Sidney J. Nethery, Chairman

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Environmental Protection Agency, Task Group 6
Crystal Mall #2, 1921 Jefferson Davis Highway
Arlington, Virginia 20460

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
Environmental Protection Agency
Office of Noise Abatement and Control
Crystal Mall #2, 1921 Jefferson Davis Highway
Arlington, Virginia 20460

13. Type of Report & Period Covered Final

14.

15. Supplementary Notes

* The report:

16. Abstracts

This document is a result of an extensive task force effort to gather all available data pertinent to military aircraft & airport noise and opportunities for reduction without inhibition of military missions. It represents the interpretation of such data by the task group chairman responsible for this specific report. It does not necessarily reflect the official views of EPA & does not constitute a standard, specification or regulation.

17. Key Words and Document Analysis. 17a. Descriptors

military aircraft noise
airport noise
noise reduction
supersonic flight
low altitude operations
land use control

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

18. Availability Statement Release unlimited

19. Security Class (This Report) UNCLASSIFIED X

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 187

22. Price 5.25

FORM NTIS-35 (10-70)

USCOMM-DC 40329-P71

PREFACE

The Noise Control Act of 1972 (Public Law 92-574) directs the Environmental Protection Agency (EPA) to study the adequacy of current and planned regulatory action taken by the Federal Aviation Administration (FAA) in the exercise of FAA authority to abate and control aircraft/airport noise. The study is to be conducted in consultation with appropriate Federal, state and local agencies and interested persons. Further, this study is to include consideration of additional Federal and state authorities and measures available to airports and local governments in controlling aircraft noise. The resulting report is to be submitted to Congress on or before July 27, 1973.

The governing provision of the 1972 Act states:

> "Sec. 7(a). The Administrator, after consultation with appropriate Federal, state, and local agencies and interested persons, shall conduct a study of the (1) adequacy of Federal Aviation Administration flight and operational noise controls; (2) adequacy of noise emission standards on new and existing aircraft, together with recommendations on the retrofitting and phaseout of existing aircraft; (3) implications of identifying and achieving levels of cumulative noise exposure around airports; and (4) additional measures available to airport operators and local governments to control aircraft noise. He shall report on such study to the Committee on Interstate and Foreign Commerce of the House of Representatives and the Committees on Commerce and Public Works of the Senate within nine months after the date of the enactment of this act."

Under Section 7(b) of the Act, not earlier than the date of submission of the report to Congress, the Environmental Protection Agency is to:

> "Submit to the Federal Aviation Administration proposed regulations to provide such control and abatement of aircraft noise and sonic boom (including control and abatement through the exercise of any of the FAA's regulatory authority over air commerce or transportation or over aircraft or airport operations) as EPA determines is necessary to protect the public health and welfare."

The study to develop the Section 7(a) report was carried out through a participatory and consultive process involving a task force. That task force was made up of six task groups. The functions of these six task groups were to:

1. Consider legal and institutional aspects of aircraft and airport noise and the apportionment of authority between Federal, state, and local governments.

2. Consider aircraft and airport operations including monitoring, enforcement, safety, and costs.

3. Consider the characterization of the impact of airport community noise and to develop a cumulative noise exposure measure.

4. Identify noise source abatement technology, including retrofit, and to conduct cost analyses.

5. Review and analyze present and planned FAA noise regulatory actions and their consequences regarding aircraft and airport operations.

6. Consider military aircraft and airport noise and opportunities for reduction of such noise without inhibition of military missions.

The membership of the task force was enlisted by sending letters of invitation to a sampling of organizations intended to constitute a representation of the various sectors of interest. These organizations included other Federal agencies; organizations representing state and local governments, environmental and consumer action groups, professional societies, pilots, air traffic controllers, airport proprietors, airlines, users of general aviation aircraft, and aircraft manufacturers. In addition to the invitation letters, a press release was distributed concerning the study, and additional persons or organizations expressing interest were included into the task force. Written inputs from others, including all citizen noise complaint letters received over the period of the study, were called to the attention of appropriate task group leaders and placed in the public master file for reference.

Task Group 6 of the Environmental Protection Agency Task Force on Aircraft/Airport Noise had as its task the considerations of the unique aspects of military aircraft operations that contribute to the broad national problem of aircraft/airport noise.

Early in the course of deliberation of this problem by the task group members it became apparent that military aircraft operations, with the exception of supersonic flight, offer no problems that are not shared by the civil aviation industry. It also became clear early in the study that potential solutions to the noise problems may in some cases be unique.

The impact of noise emanating from military aircraft/aircraft operations can be lessened by:

- Source noise reduction

- Imposition of operational constraints/procedures for noise abatement
- Land Use Control in the vicinity of airports

SOURCE NOISE REDUCTION

At the present time, the potential for large source noise reductions for strategic and tactical military aircraft does not exist. These high performance aircraft cannot accept the performance degradations associated with current source noise reduction techniques. However, source noise reduction techniques can be successfully applied to certain military aircraft that operate in the civilian as well as the military domain, such as light helicopters, transports, tankers, and patrol aircraft, without imposing excessive performance and weight penalties. The Department of Defense is conducting a comprehensive Research and Development Program to develop source noise reduction techniques that can be applied to military aircraft. This work is described in the first section of this report.

OPERATIONAL CONSTRAINTS/PROCEDURES

Flight operations of military aircraft are for the most part unique. In view of this, noise abatement procedures which are effective for civil aircraft operations may not be appropriate for military aircraft. The potential for military noise abatement constraints/procedures does exist, however, and is discussed along with recommendations in the second section of this report.

LAND USE CONTROL IN THE VICINITY OF AIRPORTS

Since a large majority of military aircraft are high performance aircraft not presently ammenable to source noise reduction techniques, land use control is the single most important method for lessening the impact of military aircraft noise on local communities adjacent to military flying installations. The Department of Defense has recognized this to be the case and has recently published an environmental impact statement on the policy necessary for the execution of land use control in the vicinity of military airports.[1] A comprehensive discussion of land use control is described in the third section of this report.

CONTENTS

Section Page

1 SOURCE NOISE REDUCTION 1-1
  - Introduction 1-1
  - Current Research and Development 1-2
  - Proposed Department of Defense Goals 1-3
  - Recommendations 1-5

2 OPERATIONAL PROCEDURE/CONSTRAINTS TO ABATE AIRCRAFT NOISE 2-1
  - Airport Environs 2-1
  - Low Altitude Operations 2-3
  - Supersonic Flight 2-5
    - Operations by Aircraft of Limited Supersonic Requirement 2-5
    - Operations by Aircraft Conducting Sustained Supersonic Activities 2-6
    - Air Force Regulation of Supersonic Flight Activities 2-6
  - Current Programs 2-8
  - Recommendations 2-8

3 LAND USE CONTROL IN THE VICINITY OF AIRPORTS 3-1
  - Overview 3-1
  - Introduction 3-2
  - The Case for Airport Environs Land Use Control 3-4
    - The Legal Basis 3-4
    - The Practical Basis 3-8
    - The Legislative Basis 3-9
  - The Airport Environs Policy Plan 3-11
    - Policy Formulation and Content 3-12
  - Defining the Airport Operations "Footprint" Basic Data Requirements 3-16
    - The Noise "Footprint" 3-22
    - The Aircraft Operations "Footprint" 3-28
  - The Airport Environs Land Use Compatibility Plan 3-29
    - Land Use Compatibility Standards 3-31
  - Implementing the Plan 3-39
    - The Land Use Plan 3-40
    - Zoning 3-41
    - Zoning Legislation 3-43
    - Implementation Strategy 3-45
    - Supplementary Methods of Zoning 3-48
    - Zoning Alternatives 3-51
  - Findings 3-54
  - Recommendations 3-55

REFERENCES R-1

APPENDICES

  - A - Task Group Membership A-1
  - B - Responses from Task Group Members B-1

LIST OF TABLES

Table		Page
1-1	Department of Defense Noise Research Programs	1-7
1-2	Proposed Department of Defense Military Aircraft Noise Reduction Goals	1-8

LIST OF ILLUSTRATIONS

Figure		Page
3-1	Flight Patterns	3-18
3-2	Flight Profiles	3-19
3-3	Composite Noise Rating Map	3-25
3-4	Accident Hazard Zones	3-27
3-5	Airport Environs Land Use Compatibility Plan	3-30
3-6	Airport Environs Land Use Compatibility Plan	3-36
3-7	Land Use Compatibility Matrix	3-37

SECTION 1

SOURCE NOISE REDUCTION

Aircraft noise is a problem of considerable concern to the military services. High noise levels are detrimental to personnel, contribute to structural failures, and degrade the general community environment. The military services recognized this hazard early in the 1950's and initiated extensive noise control programs. Comprehensive bioacoustic research efforts were conducted in order to assess the effects of high noise levels on personnel. As a result of these programs, allowable noise exposure limits were developed. Ear protection devices were issued to all personnel exposed to excessive noise, and hearing conservation programs were initiated. These early bioacoustic research efforts formed the basis for much of the current work on subjective response to aircraft noise.

With the advent of the jet engine, the problem of acoustically induced fatigue in aircraft structures became more predominant. In response to this problem, extensive capabilities for sonic fatigue research were developed. Sonic fatigue reduction techniques and effective noise suppression panels for interior noise control were developed. Very little effort was directed toward reducing the source of the noise, since at that time all aircraft noise reduction techniques were accompanied by intolerable performance, weight, and cost penalties. However, the military services have conducted comprehensive research and development programs on source noise generation and reduction.

The most elusive problem is community annoyance. In order to partially alleviate this problem, the military services initiated programs to develop effective ground run-up suppression equipment. This effort, together with a limited noise abatement operational constraint program and a major program of land use planning, represented the military's principal weapons against noise pollution. These efforts are now being expanded and, in addition, new efforts are being initiated to reduce military aircraft noise at the source.

CURRENT RESEARCH AND DEVELOPMENT

The Army, Navy and Air Force are conducting a number of aircraft noise control research and development programs. Army efforts emphasize helicopter noise generation, propagation, and reduction. The Navy is concentrating on the development of new ground run-up suppression techniques and assessments of the noise environments of aircraft carriers. The most extensive research and development efforts within the Department of Defense to control aircraft noise are being conducted by the Air Force. These efforts include the areas of bio and psycho acoustics, propulsion and aircraft acoustics, and aircraft noise measurement. Specific details concerning the Defense Department's aircraft noise research programs are presented in References 2 to 6. A brief summary of these programs are provided in Table 1-1. Much of the technology developed under these programs is applicable to the solution of both military and commercial noise problems. Therefore, the Department of Defense is conducting several noise research efforts jointly with other agencies of the federal government, including the Department of Transportation, the National Aeronautics and Space Administration and the Environmental Protection Agency.

Some of the current noise abatement techniques that can be applied to reduce aircraft/engine noise include:

- New quieter engine designs with components and engine cycles designed for lower noise.
- Exhaust silencers for reciprocating and turbine engines.
- Acoustically treated nacelles and ducts.
- Noise suppression for on-board auxiliary power units.
- Rotor and propeller aerodynamics for reduced noise.
- Noise suppression for mechanical components such as helicopter gear boxes.
- Vehicle aerodynamics to allow for steeper ascent and descent, and reduction in time required for ascent/descent.

However, before any of these techniques can be applied to military aircraft, the impact of these techniques on system performance must be carefully and comprehensively assessed. In order to achieve maximum noise reduction for minimum penalty, performance/noise/cost trade studies should be conducted early in the development of each new aircraft and engine system. These studies, coupled with expected technology advances, will aid in the practical application of noise control techniques to future military aircraft.

PROPOSED DEPARTMENT OF DEFENSE GOALS

Application of current and future Federal Aviation Administration noise regulations to all military aircraft would not be in the best interests of the national defense.

The ability of a military aircraft system to meet noise standards depends primarily on the missions the aircraft are required to undertake. Current noise reduction techniques can be successfully applied to certain aircraft that operate in the civilian as well as the military domain (light helicopters, transports, tankers, and long range patrol aircraft) without imposing excessive performance and weight penalties. The cost of such techniques, however, is significant. High performance aircraft (fighters, bombers, and tactical helicopters), whose mission requirements are demanding, would incur significant performance penalties if they were subjected to current noise suppression techniques. Therefore, the Department of Defense must continue to search for techniques that can be applied to high performance aircraft and helicopters without adversely affecting their mission capabilities.

Recently, the Department of Defense conducted an intra-agency study on environmental quality. One of the major objectives of this study was to develop a coordinated long range plan for environmental quality research. The study included a discussion of the feasibility of developing source noise reduction goals for future military aircraft. At the present time there are no comprehensive set of source noise reduction goals for military aircraft. The Air Force has established a maximum noise limit for engines developed under the proposed Advanced Turbine Engine Program (ATE) discussed in the Task Group 4 Report on Noise Source Abatement Technology. This limit was established to insure that future military aircraft using these engines will meet current Federal Aviation Regulation Part 36, and that commercial derivatives of the engine will enable future commercial aircraft to meet FAR 36 minus 10 EPNdB.

The Air Force Aero Propulsion Laboratory has formulated source noise reduction goals for current and future military aircraft and has recommended that these goals be adopted by the Air Force and the Department of Defense. The goals were developed under the premise that source reduction techniques can be applied to certain classes of military aircraft without inhibiting military missions. The goals address two separate classes of aircraft-strategic/tactical aircraft and transport and other selected aircraft. Strategic and tactical aircraft include fighters, bombers, interceptors, tactical helicopters, etc. Transport and other selected aircraft include cargo aircraft, CTOL and STOL transports, navigator trainers, tankers, certain reconnaissance aircraft, long range patrol aircraft, etc. These goals are summarized in Table 1-2.

RECOMMENDATIONS

1. Based on information collected during the Aircraft/Airport Noise Study, source noise reduction techniques can be effectively applied to certain classes of military aircraft. Therefore, the Department of Defense should establish a definitive policy to implement the application of source noise reduction technology to future military aircraft systems, to set allowable noise limits for these classes of aircraft, and to develop a noise certification procedure to insure compliance.
2. In order to develop a data base to assess environmental impact, performance/noise/cost tradeoffs should be conducted during the preliminary design and development phases of all future military aircraft systems. The Department of Defense should establish a definitive policy to insure that these performance/noise/cost trades are conducted.
3. Noise Retrofit Performance/Cost Trades should be conducted on current military aircraft to determine the feasibility of a selective retrofit program to reduce noise at the source. The Department of Defense should establish a definitive policy to insure that these retrofit studies are conducted.
4. The Congress should support the Department of Defense in a continuing program of research and development to reduce military aircraft noise at the source.
5. The Department of Defense should continue to conduct interagency efforts such as the Army/NASA Rotor Noise Research Program and the Air Force/Department of Transportation Jet Noise Research Program. Such programs avoid needless duplication of effort and provide the maximum utilization of personnel and funding.
6. The Environmental Protection Agency should reestablish and adopt the charter of the Interagency Aircraft Noise Abatement Program (IANAP) to coordinate all research and development associated with Aircraft/Airport noise. IANAP successfully coordinated aircraft noise control activities for a number of years and, therefore, should be continued. The Department of Defense should continue to coordinate military aircraft noise control activities with the Environmental Protection Agency through IANAP.

TABLE 1-1

DEPARTMENT OF DEFENSE NOISE RESEARCH PROGRAMS

R&D PROGRAM	AGENCY	FUNDING ($1000)	
		FY73	FY74
BASIC RESEARCH			
Propulsion/Aerodynamic Noise	Air Force Office of Scientific Research	235	227
Inlet/Exhaust Noise Suppression	Air Force Aerospace Research Laboratory	10	10
Helicopter/Aerodynamic Noise	Army Research Office--Durham	180	182
Combustion Noise	Office of Naval Research	42	-
EXPLORATORY RESEARCH			
Bio/Psycho-Acoustics	6570th Aerospace Medical Research Laboratory	207	166
Supersonic Jet Noise	Air Force Aero Propulsion Laboratory	125	125
	Department of Transportation	545	540
Small Engine Noise	Air Force Aero Propulsion Laboratory	41	-
Compressor Noise	Air Force Aero Propulsion Laboratory	10	50
Propeller Noise	Air Force Aero Propulsion Laboratory	26	17
Quiet Aircraft Propulsion	Air Force Flight Dynamics Laboratory	170	-
	Air Force Aero Propulsion Laboratory	125	-
Helicopter Noise	Army Air Mobility R&D Laboratory	400	400
Combustor Noise	Army Air Mobility R&D Laboratory	40	40
Ground Run-Up Suppression	Naval Air Propulsion Test Center	750	350

TABLE 1-2

PROPOSED DEPARTMENT OF DEFENSE MILITARY AIRCRAFT NOISE REDUCTION GOALS

AIRCRAFT CLASS	SOURCE NOISE REDUCTION GOALS
• STRATEGIC/TACTICAL AIRCRAFT	• OPERATIONAL AIRCRAFT • Rely on Land Use Planning, Operational Constraints/Procedures, Ground Run-Up Suppression • FUTURE AIRCRAFT • Noise/Performance/Cost Trades • Noise Reduction Without Performance Loss
• TRANSPORT/OTHER SELECTED AIRCRAFT	• OPERATIONAL AIRCRAFT • Noise Retrofit/Performance/Cost Trades • Selective Retrofit to Meet FAR 36 Based on Tradeoff Analyses • FUTURE AIRCRAFT • Noise/Performance/Cost Trades • Meet Current FAR 36 Noise Requirements as a Minimum • Employ State-of-the-Art Noise Control Technology to the Greatest Extent Possible • Approach Future Commercial Noise Regulations to the Greatest Extent Possible

SECTION 2

OPERATIONAL PROCEDURE/CONSTRAINTS TO ABATE AIRCRAFT NOISE

The noise problem surrounding military aircraft operations emanate from three general sources:

1. Noise produced by aircraft operating on and around airports.
2. Noise produced by aircraft conducting low altitude operations other than that conducted in the airport environs;
3. Sonic booms produced by supersonic flight activities.

The noise problem has been aggravated by the continuous introduction of more complex and sophisticated aircraft, as the performance demand of each new aircraft designed to provide for our Nation's defense dictates the production of aircraft with jet engines of greater thrust to move a greater payload at a higher speed.

The noise characteristics and the mission requirements surrounding the three general military noise sources listed above are so diverse that each of the operations will be treated separately. Data presented herein will be general, and information confined to flight operations conducted over the United States.

AIRPORT ENVIRONS

In the course of the Task Group's deliberations, the feasibility of imposing operating restrains/restrictions, both in flight and on the ground, and the development of operating procedures which would alleviate the noise of military aircraft, was explored. These actions can reduce the size and duration of the noise contours of the affected air installation and change aircraft flight routes and in certain applications, these actions should be able to reduce or eliminate the overall noise emanating from an airfield. In this discussion, no quantitative estimate of the noise reduction possible is made.

It is not an easy task to accurately define what actually is an operational constraint or what is an operating procedure. The following list of constraints and procedures illustrates this point.

Operational constraints include such items as:

- Restrict hours of operation
- Prescribe number of operations permitted per unit of time
- Limit operations on weekends and holidays
- Limit areas in which operations may be performed
- Prohibit certain operations

Operational procedures include such items as:

- Use of non-standard techniques; e.g., high gliding, low power approaches; fast, no flap approaches, etc.
- Minimum power takeoffs, power reductions
- Non-standard departures and arrivals
- Adjustment of flight patterns.

An aircraft required to make a departure turn to the right, instead of the "standard" left turn to comply with ATC procedures does not constitute an operating constraint, but rather a procedure, however, restricting all turns to the right at fields where multi pilot aircraft are used for pilot training (all such aircraft are piloted from the left side) is a constraint of considerable magnitude, and such a constraint where Field Carrier Landing Practice is conducted would be unacceptable.

Restricting air operations or ground runups during the late hours of the evening (e.g., 220-0600) to only operations of necessity is essentially no restriction at all since, with few exceptions, this is the only activity carried out during this time period.

The training evolution of individual pilots and units requires the capability for flexible planning. Level of experience of assigned pilots, weather, target availability, hours of darkness, etc., require continuous adjustment to immediate, short range and medium range plans to achieve a proper readiness stature. Prohibitive restrictions concerning frequency of evolutions could only lead to a derogation of readiness, therefore, commanders must have the option, implemented wisely, to conduct the training he sees as necessary to maintain readiness.

Aircraft traffic patterns must be looked at in light of mission requirements. Some adjustments may be made to alleviate noise. However, many of the apparent changes are not feasible, e.g., "why not make right turns away from residential areas at field "X"? This may not be possible due to conflicting traffic with other airports or, as mentioned previously, is not compatible with training situations of inexperienced pilots.

Present operating techniques developed for each aircraft are optimum for maximum performance in any particular mode of operation. Development of "quiet" operational procedures have not been explored except on a local basis. However, it must be noted that standard operating procedures have been shown to be directly related to flight safety. Burdening pilots with multitudinous aircraft operating techniques for various air installations and various aircraft operating conditions (e.g., wind velocity, humidity, weight, etc.) over what is currently done must be approached very carefully to avoid derogation of safety.

LOW ALTITUDE OPERATIONS

The military services have a continuing requirement to conduct low altitude training flights at or below 1500 feet above the surface in excess of 300 knots indicated airspeed. This training is essential in maintaining the capability of penetrating an enemy radar defense system. Normally, this type of training is not conducted during the hours of darkness. All missions of this type must be conducted on routes published by the DOD.

1. Routes are designed to avoid:
    a. Control zones, control zone extensions, airport traffic areas, and terminal control areas.
    b. All known uncontrolled airports to the extent possible.
    c. Control areas and transition areas to the extent possible.
    d. Populated areas to the extent possible so that the adverse effects of speed and sound to persons and property on the ground are minimized.
2. Additional factors pertaining to these routes:
    a. The speed shall be the minimum subsonic speed required for the particular operation.
    b. Routes are flown only when the ceiling is at least 3,000 feet and visibility at least five miles.
    c. Route users effect inter-and-intra-service coordination and share use of routes to the maximum practicable extent to minimize the number of low altitude routes.
    d. Routes are coordinated with Flight Standards and Air Traffic Control Divisions at the appropriate FAA Regional Office to minimize impact on their airspace users.
    e. The affected public is advised of these routes by publicizing of the routes.

The military also conducts low altitude flight operations in restricted visibility conditions. This type of operation is normally conducted by bomber aircraft on a route that terminates at a Radar Bomb Scoring (RBS) facility. Aircraft are normally flown at 500 feet above the surface during daylight hours and at 800 feet during the hours of darkness. When visibility decreases to five miles or less the aircraft climbs to a higher altitude and proceeds in accordance with Instrument Flight Rules. Once an RBS site is selected, the Strategic Air Command and the Federal Avaiation Administration jointly design a route in accordance with established criteria, one of which is to avoid population centers. These routes are also published and publicized.

SUPERSONIC FLIGHT

In order to perform the Navy and Air Force mission it is necessary to conduct operations which involve supersonic flight over the United States. Air Force flight operations resulted in approximately 1,500,000 nautical miles of supersonic flight annually during 1970-1972. This represents approximately 98% of the total military supersonic flight activities conducted over the U.S., with Navy activity accounting for the remaining activity. Based upon the total number of hours flown by the Air Force during the same period, the supersonic flight operations represent approximately .0003 of the total Air Force flight operations, the Navy's even less.

The military supersonic operations fall into two general categories:

1. Operations of short supersonic duration conducted by fighter/interceptor-type aircraft.
2. Sustained supersonic operations conducted by high altitude reconnaisance aircraft.

OPERATIONS BY AIRCRAFT OF LIMITED SUPERSONIC REQUIREMENT

Supersonic operations of short duration are conducted by fighter/interceptor-type aircraft capable of short supersonic dashes in the accomplishment of special mission requirements which comprise an extremely small part of their overall mission. This category generates more than 95% of the military supersonic flight activities, but is responsible for less than 50% of the supersonic miles flown. All Navy supersonic requirements fall in this category. The activities include those conducted in undergraduate pilot training, interceptor training, aerial combat tactics training, research flights, and aircraft acceptance flight checks. Most of these missions can be highly responsive in eliminating overflight of sensitive areas, as the underlying environs do not contribute to mission accomplishment. The primary operational requirement is that the flights be conducted in airspace separated from other air traffic that is within reasonable range of the air base (not to require aerial refueling).

OPERATIONS BY AIRCRAFT CONDUCTING SUSTAINED SUPERSONIC ACTIVITIES

Certain Air Force supersonic reconnaissance aircraft flying above 70,000 feet normally cruise at speeds of Mach 3. As previously stated, this mission generates more than 50% of supersonic nautical miles flown by military aircraft. To accomplish its assigned mission, a large percentage of reconnaissance aircraft activities must be conducted over land to accomplish valid training. Some of the operational problems in avoiding all areas sensitive to booms becomes apparent with a profile view of an average mission. An average training mission traverses approximately 2500 nautical miles, and based upon an estimated boom exposure width of 70 miles at cruising altitude, approximately 175,000 square miles of terrain underlying the flight track could be exposed to the audible boom on a single flight. Additional operational constraints include a limited maneuvering capability during certain critical portions of a flight, a nominal aircraft turning radius of 90 miles which limits avoiding sensitive areas close to each other, airspace limitations caused by the necessity to separate climb, descent and refueling corridors from other air traffic, and the necessity to fly over certain ground installations to calibrate and assess the unique equipment aboard the aircraft.

AIR FORCE REGULATION OF SUPERSONIC FLIGHT ACTIVITIES

As supersonic flight requirements expanded with the introduction into the Air Force of more sophisticated aircraft, it quickly became apparent that compatibility of the Air Force mission with the environs demanded that the selection of supersonic flight corridors be closely controlled to minimize the impact upon the underlying areas. Unilateral limitations on supersonic flight were incorporated in 1967 into Air Force Regulation 55-34, "Reducing Flight Disturbances that Cause Adverse Public Reactions." These policies have been continually reviewed and adjusted, and the current directive is attached.

As a matter of Air Force Policy (the Navy has a similar policy) the generation of sonic booms is not authorized except during:

1. Strategic Air Command and North American Air Defense Command exercises approved by the Joint Chiefs of Staff and only to the extent required to achieve command objectives.
2. Aerospace Defense Command flights engaged in active air defense missions.
3. Tactical missions which require supersonic speeds.
4. Phases of formal training courses and proficiency flights which require supersonic speeds. When such flights are necessary, they are conducted over specially designated areas and are closely supervised.
5. Research, test, and operational suitability check flights which require supersonic speeds. These flights are also conducted over designated areas.
6. Demonstrations specifically authorized by a major command. Such flights are coordinated in advance with Air Force Headquarters.
7. Any Emergency when, in the judgement of the pilot, safety justifies a deviation from this general policy.

When supersonic operations are required, flights are conducted at altitudes above 30,000 feet over land areas, and above 10,000 feet over open water areas (at least 15 miles from the nearest shoreline). Metropolitan areas (100,000 or more population), all National Parks, and other critical areas specified by the Air Force, will be avoided by one-half mile for each 1,000 feet of altitude. Some exceptions are noted in the regulation. Current specified critical areas to be avoided include certain National Monuments identified as fragile by the National Park Service.

To insure close control in this area of flight operations, the Air Force has a Sonic Boom Reporting System with a computerized repository. Commanders of all Air Force and Navy units utilizing aircraft capable of supersonic speeds are required to insure that reports of all flight activities at or above Mach One (a speed equal to that of sound) are properly recorded on a Sonic Boom Log and forwarded to the repository. The information included in each report provides the date, time starting and stopping locations of the supersonic activity, the Mach number, altitude, aircraft serial number, and reporting base. This information is used primarily to substantiate damage claims against the DOD.

CURRENT PROGRAMS

In summary, the following programs are currently being pursued in the interest of noise abatement.

- Ground noise suppressor. Acquisition of both in frame and out-of-frame suppressors has been and continues to be pursued.
- Use of satellite airfields in remote areas to conduct especially noisy or repetitive evolutions.
- Headquarters level directives, which control:

  Supersonic flight operations

  Minimum altitudes over specified areas

  Annoyance to the civilian population

  Permissible activities

  General noise abatement policies
- Further, there are few airports without self imposed restrictions, e.g. no afterburner take-offs after 2200 hours, no ground run-ups after 2200 hours, etc.
- Continual review of low level training routes.

RECOMMENDATIONS

In view of the above the Environmental Protection Agency will request that the Department of Defense undertake a comprehensive analysis of its aircraft operating constraints and procedures to determine what can be done specifically to further reduce the noise impact from aircraft operations without compromising flight safety or National defense needs. And that any new noise abatement procedures identified by this analysis be incorporated into the Department of Defenses flight operations at the earliest possible time.

In order to further balance the effort to reduce the impact of noise from military aircraft it is recommended that the Congress continue to support the Department of Defense in the continuing program of acquisition of ground maintenance noise suppressors.

SECTION 3

LAND USE CONTROL IN THE VICINITY OF AIRPORTS

OVERVIEW

This section summarizes the results of applied research conducted at Headquarters, Air Training Command, Base Master Planning. The purpose of this section is: (1) the identification and appraisal of the conflict between land use and aircraft operations, (2) the identification and description of legislative requirements and (3) the description of an airport environs planning methodology. This methodology, developed for use at U.S. Air Force (Air Training Command) bases, is constantly being refined and updated as new information becomes available through both research and actual experience.

The section discusses the justification and requirement for airport environs land use planning in legal, economic, legislative, political and practical terms. The scope of airport environs land use planning determinants is identified and discussed. National, state and local legislative efforts, such as the National Land Use and Policy Planning Assistance Act of 1973 and several state acts, are discussed.

Drawing from research and case studies, an Airport Environs Policy Plan is presented. An airport land use planning methodology is developed from flight operational data, flight patterns, flight profiles, accident histories and plots, flight characteristics, aircraft types and long term projections. The "how to do it" aspects of drawing the aircraft operations "footprint" are detailed.

The Airport Environs Land Use Compatibility Plan is developed using an area called the Compatible Use District and comprehensive land use standards.

An implementation strategy is overviewed in terms of integrating the Compatible Use District System with comprehensive land use plans. The zoning process is discussed using court cases and legal review. Zoning legislation in selected states is summarized and compared. Specialized zoning methods and alternative implementation methods are cited. Findings are summarized and recommendations are suggested.

INTRODUCTION

The immediate requirement to plan the use of land throughout the United States is critical. Even though some land use has been planned for centuries and the planning process is now evolving at an accelerating rate, many believe that the time may have already passed to solve the land use problem.

This concern is being translated into action in many places. The Land Use Policy and Planning Assistance Act of 1973 (S. 268 and S. 924) is now pending before the Congress. Many state legislatures are currently considering legislation similar to S. 268 and/or the American Law Institute (ALI) Model Land Use Development Code. Planning agencies at all governmental levels are proliferating throughout the country.

The evolution and recognition of planning is the logical reaction of a society which has increased substantially in both numbers and geographic density concentrations. Areas which were once part of agricultural America (and environmentally "clean") are suddenly becoming urban. Simultaneously, the American public is demanding environmental quality. The complexities of this modern society will not allow us to retrace our steps back to the frontier days of the nineteenth century. Granted, many people are returning to the "land" but the bulk of the American population is urban centered.

Herein lies the challenge. What can be done to maintain "necessities" of life in a modern world without destroying or impairing life itself? Is it possible for man and his activities to exist with man himself and the natural order without serious negative environmental results? The planner must respond with an affirmative reply, citing environmental land use planning as his answer.

Simply stated, the planner must negotiate the compromise between conflicting planning elements. He must fully inventory and evaluate what exists as natural or man-made fact. He must then produce and implement plans for future compatibility among planning elements while, at the same time, eliminating as many negative impacts as possible.

This discussion is concerned with a portion of the environmental land use planning process: that of the airport and adjacent land use. Airports and their impacts are real. They are here to stay. However, there exist serious conflicts between many airports and the land areas in their environs. It is suggested that solutions to these conflicts can be achieved through the skillful employment of the environmental land use planning process.

For purposes of this paper, planning is defined as "a process for the rational choices between alternative futures assuring orderly physical growth with the ultimate objective of the protection and promotion of the public health, safety and welfare as well as economic and social stability."

Such planning is long range and comprehensive. It is a means to bring technical and professional inputs into the political decision-making process. It is a method by which long range objectives can be translated into short range actions. It is designed to achieve a rational compromise between the public and private interest.

There is virtually unanimous agreement among planners and others associated with airports that compatible land use adjacent to these installations is imperative. There has been, and still is, considerable confusion and disagreement concerning how to effectively accomplish this task. Throughout the evolution of airport land use efforts, there have been recurring difficulties and deficiencies. These problems essentially fall within four categories:

1. Legislation - The necessary state enabling acts have generally been omitted from state laws. Those that do exist are basically inadequate. Without legislation which specifically recognizes the requirement for airport environs compatible land use, realistic solutions cannot be achieved.

2. The Courts - The results of litigation concerning nuisance, damage, trespass and taking without due compensation have generally been against the airport operator, even when the airport was there first.

3. Technology - The means by which the impact of aircraft operations can be evaluated in terms of noise and accident hazard have been slow in developing. Substantive efforts in noise evaluation have been confined to the last 10 to 15 years.

4. Planning - Planners have not produced systems of land use compatibility based on all aircraft land use determinants to effectuate adequate installation and area inhabitant protection through rational and reasonable criteria.

THE CASE FOR AIRPORT ENVIRONS LAND USE CONTROLS

It is human nature to wait until a problem exists before substantive commitments are made. This is, of course, understandable when one considers the fact that all things cannot be accomplished simultaneously. Commitments are made on the basis of priorities. It then follows that the solution of the airport land use problem must begin with the recognition that there is, in fact, a problem and that if it is not resolved the results will be unacceptable.

THE LEGAL BASIS

In its purest sense, government exists to serve the people. Land use legislation, particularly zoning, was designed to protect people from threats to health, safety and general welfare. In the early days of zoning, it was used to prevent the construction of such things as slaughter houses in residential neighborhoods. Zoning has evolved considerably since then but health, safety and welfare remain paramount. It is within this framework that the airport land use question must be discussed.

In terms of safety, airport operations pose a greater threat than most other land uses. Many governmental jurisdictions now prevent or limit construction and certain land uses due to flood plains, steep slopes, poor soil stability and so forth, but few do so because of aircraft operations. Airplanes crash and people die. That is a fact, as is the certainty that there will be floods in flood plains.

Within the last six months, there have been a number of aircraft crashes near airports with significant loss of life:

-November 1972 - A civilian owned sabre jet crashed during takeoff into an ice cream parlor at the end of the Sacramento Executive Airport runways. Twenty-two persons in the building died. The State of California had opposed the shopping center development. It was built anyway.[7]

-December 1972 - A United Airlines 737 crashed, while landing, into a residential area less than two miles from Chicago's Midway Airport, killing 43 passengers and two persons on the ground. It was reported that more passengers would have survived had it not been for the fact that part of the aircraft was inside a house.[8]

-December 1972 - A Lear jet crashed, while taking off from Detroit's Metropolitan Airport, into a four million gallon gasoline tank killing all aboard and one man on the ground.[9]

-December 1972 - A twin engine Cessna crashed into two homes shortly after takeoff from Buffalo International Airport. Three people on board and three in the houses were killed.[10]

-February 1973 - A Lear jet, while taking off at Atlanta, struck a flock of birds (allegedly from a sanitary land fill near the runway end) and crashed into a wooded area after hitting an apartment building, killing all aboard.[11]

Although there were other crashes during this time period, those cited have two things in common: the crashes were in the immediate vicinity of the airport during takeoff or landing, and they either killed or narrowly missed killing people on the ground. Had there been effective airport land use compatibility zoning, persons on the ground would not have been exposed to this hazard and personnel in the aircraft would have had a better chance for survival.

Although the danger to ground level activities from aircraft operations can be disastrous, the converse is also true. Tall structures, confusing light emissions and other similar land based activities pose serious hazards to low level flight. Many states have long recognized this relationship and have enabling acts which allow local authorities to enact zoning ordinances which prevent land uses potentially hazardous to aircraft operations. Of the acts reviewed, none allow land use zoning per se.[12]

The intent of these acts is to establish height limitations, control electrical emissions, etc. They are designed to protect flight operations only. No concern is given to the inhabitant of the land in terms of his safety. Some ordinances under these state acts include such things as residential exclusions but they would probably be thrown out by the courts because the enabling acts generally do not allow such regulation.

The list of unnecessary deaths due to land use incompatibility would be very long. Numerous crashes have occurred in the history of aviation when aircraft met obstructions. Most states reacted positively. It is only reasonable that a similar response is warranted to protect land users from the type of deaths previously cited. Such a response is clearly within the zoning mandate to protect and promote safety.

Airport land use regulation must also consider health. It is becoming more apparent that the noise produced by low-flying aircraft results in health hazards to area inhabitants. This health hazard must be considered in several ways. Firstly, it is known that exposure to high noise levels over long periods will damage hearing. Scientific research indicates that this is the case in limited areas around airports.[13] The far reaching health hazard of noise is psychological or mental. Scientific data on this point is limited. The main body of knowledge is from psycho-acoustic and social surveys. This information has been translated into what is called "anticipated community response."[14] Although it is largely subjective, such data are real in that people do perceive certain noise conditions to be detrimental. It is also on this basis that court decisions are being made.[15]

Unfortunately the aircraft noise problem is difficult to handle effectively. Aircraft noise is dependent on many variables. It is extremely complicated in that the number of flights, runway utilization, time of day and many other factors determine the extent of noise exposure. Simply stated, aircraft noise exposure is considerably different from that produced by a machine running at a constant rate with a steady noise output. Short of having a computer program that can say a person will go deaf in so many years at location XYZ, the planner, local governments and the courts must use the best available tools.

The third basic zoning consideration is that of the public welfare. Public welfare can be construed to mean many things. In the case of airports the public welfare is clearly economic. Most airports were originally located some distance from the city being served or other urbanized areas. As population increases, so does the demand for land. Since airports attract economic growth, development gradually surrounds the airport. For many land uses this is economically and practically sound. Certain industrial, business and airport support functions owe their existence to the airport. These land uses, as well as the airport, attract other uses which are not compatible with airport operations. Over time, those directly dependent on the airport are overcome by a majority who do not care about the airport. Many are unwary home purchasers who work elsewhere. Finally these people initiate legal or political action against the airport. The airport either pays, curtails or alters operations, relocates or closes entirely.[16]

Such situations affect the economic welfare in two primary ways. The airport is a major industry which produces substantial amounts of primary money for the local economy as well as primary jobs.[17] In any case, these primary dollars are affected. In some communities, particularly where there are military airports, the loss of dollars due to base closure can be disastrous.[18]

The second way the economic welfare is affected is through the waste of public tax dollars. Most major airports are owned by some level of government. They are multimillion dollar investments.[19] If they are closed or replaced the taxpayer pays the price. In terms of the public trust it is the duty of those in government to protect this investment.

The control of land use within the vicinity of airports clearly falls within the zoning purpose of protecting and promoting the health, safety and welfare. The means to achieve compatibility within this framework must be developed.

THE PRACTICAL BASIS

The United States public demands adequate, safe air transport service and a ready national defense organization. Loss or compromise of either because of urban encroachment is not justified.

If an installation is forced to close, it may be replaced or the service transferred to another location. In any case, there will be an economic loss. If the service is transferred to another location, the level of service and convenience may decline.

If flight operations are altered due to the presence of encroachment, safety hazards may result. Takeoff power may be reduced. Glide paths may be steeper. Patterns may be altered. Each of these modifications may be a safety compromise that could have been avoided.

With reference to military airports, closure due to encroachment endangers the national defense. The unknowing might say that the elimination of a single air base really does not matter. This is simply not the case. Each military airfield has a specific role in the national defense program. There have been many closures since World War II and as a result the inventory of usable installations has decreased significantly. The options, short of building entirely new installations, are severely limited.

The nation's airspace is becoming more and more limited due to the tremendous increase in commercial and general aviation. When all the airways are overlayed on the United States it becomes quite clear that there are few areas left with essentially unencumbered airspace. Such airspace is vitally important to the U. S. military.

Most military training areas are located in these areas for the obvious reason. If such training installations are eliminated due to encroachment this airspace advantage will be lost.

In terms of health, safety, welfare and plain common sense, it is readily apparent that all efforts should be made to maintain existing airports without limitations due to incompatible land use. Quite frankly, there are no valid arguments to justify incompatible land use around airports. The free market system of land economics requires that a landowner is entitled to a reasonable return from his land. Compatible land use planning will not prevent such economic return. It means that certain uses will not be allowed in certain areas. That is exactly what zoning is all about.

THE LEGISLATIVE BASIS

It is often said that whenever a problem is identified the solution is to simply legislate it out of existence. Even this oversimplification has an element of truth in the airport land use question. Unfortunately, legislation is often the only means by which problem solution may begin.

The regulation of land use in the United States has traditionally been exercised by the states through delegation to the local governments. For the most part this has worked in the past. This concept of total local control is currently undergoing critical review and the indications are that the land use planning process is about to change through national legislation.

During the 92nd Congress, three bills were introduced which would have established a National Land Use Policy: S. 632 (Jackson Bill), S. 992 (Administration Bill) and H. R. 7211 (Aspinall Bill). Each of these bills would have required that the states implement a comprehensive planning process, designate areas of critical concern and develop plans. Penalties would be levied for non-compliance. Each of the bills would have required specific measures concerning unique ecosystems and areas or facilities of greater than local concern. The airport land use compatibility question falls within the scope of these bills.

None of the bills was enacted into law. The Land Use Policy and Planning Assistance Act of 1973 (S. 268 and S. 924) is now before the Senate. With reference to the airport land use compatibility problem, Sec 303(d) is quoted:

> "Any method of implementation employed by the state shall include the authority of the state to prohibit, under state police powers, the use of land within areas which, under the state land use program, have been designated as areas of critical environmental concern, which are, or may be impacted by key facilities, or which have been identified as presently or potentially subject to development and land use of regional benefit, large-scale development, or large-scale subdivisions, which use is inconsistent with the requirements of the state land use program as they pertain to areas of critical environmental concern, key facilities, development and land use of regional benefit, large scale development, and large scale subdivisions."[20]

It is quite clear, that it is only a matter of time until the states will be forced to resolve their land use problems. Several states are well into the process. The State of Florida enacted the Florida Environmental Land and Water Management Act of 1972 in its last legislative session. The Act, modeled along the lines of the American Law Institute Code[21] authorizes the "state land planning agency to recommend, and the administration commission to designate, areas of critical state concern and to specify principles for guiding development therein." The Act further authorizes "local governments to adopt appropriate land development regulations for such areas subject to approval of the state land planning agency."[22]

In the State of Washington, the State Land Use Planning Commission has prepared legislation[23] which would designate "airports and seaports of state and/or federal interest" as development of greater than local impact.[24] Such designation is designed to ensure that "the net impact is in the best interest of all affected state citizens.[25]

The Washington Act also includes a significant provision in Sec 4-501 which states:

> "... the state agency may exercise emergency power to designate areas of state-wide significance and or development of greater than local impact as specified in part 5 of this article. The state agency shall develop regulations, including regulations for the granting and denial of development permits, for areas of state-wide significance, flood plains and/or development of greater than local impact and submit them to the governor for his approval."[26]

The signals are clear. Legislators have recognized the problem and they are in the process of strongly urging the states and local governments to implement the planning process for areas such as the airport environs. These legislative actions plus the health, safety and welfare and practical considerations form the case for airport environs land use controls. How then are these factors translated into substantive implementation programs?

THE AIRPORT ENVIRONS POLICY PLAN

Land use planning is accomplished through a process of phases. Generally, these phases are survey, analysis, plan and implementation. Preceding these phases is the formation of a policy plan which sets forth the framework within which the planning process will be conducted, although it will evolve and change as phases of the process are completed. The policy plan is vitally important because it constitutes the general statement of objectives.

The policy plan is developed by the planner with his client. In this plan, the planner attempts to frame the problem and translate his client's desires into policy statements. These policies become the basis of the land use regulation system. They serve as the standard by which all airport land use planning and zoning decisions are made and evaluated. These policies can also serve as the purpose or intent statements of legislation or ordinances.

Frederick H. Bair, Jr., the noted zoning authority, states:

> "The first, and perhaps major, virtue of intent statements is that they force drafters to relate regulations to defensible public purposes, they also serve as a guide to the courts and may be both a guide and a defense for local legislative bodies. In the absence of such statements, courts are hesitant to speculate as to any special intent of the legislative body."[27]

The Policy Plan may also be used as the planning document often required by state zoning law. Most states require that zoning be compatible with a comprehensive plan. For example, the State of Arizona requires that:

> "The commission shall formulate and adopt a comprehensive long term county plan for the area of jurisdiction. The county plan, with accompanying maps, plates, charts and descriptive matter shall show the commission's recommendations for development of the area of jurisdiction together with general zoning regulations."[28]

The State of Nebraska is more specific on this requirement where state law says:

> "Such regulation (referring to zoning) shall be made in accordance with a comprehensive development plan which shall consist of both graphic and textual material and shall be designed to accommodate anticipated long-range future growth which shall be based upon documented population and economic projections."[29]

The policy plan can meet the plan requirements of state law in addition to providing a practical decision-making guide. In some cases, such policies must be supplemented by graphic material, although the fact remains that the policy statement is definitely needed.

POLICY FORMULATION AND CONTENT

The drafting of airport environs planning policies is based on the factors discussed in the preceding section. If the problem is properly identified and well stated, policy writing is relatively easy. For instance, it has been established that airport land use controls must promote and protect the public health, safety and welfare. The policy for this purpose can be stated as follows:

Policy #1

HEALTH, SAFETY AND WELFARE

In order to promote the public health, safety, peace, comfort, convenience, and general welfare of the inhabitants of the airport environs, it is necessary to:

1. Guide, control and regulate future growth and development.
2. Promote orderly and appropriate use of the land.

3. Protect the character and stability of existing land uses.
4. Prevent the destruction or impairment of the airport and public investment therein.
5. Enhance the quality of the areas affected, and
6. Protect the general economic welfare by restricting incompatible land use.

With the general planning purpose established, it is necessary to provide additional refinement in terms of specific implementation action:

Policy #2

IMPLEMENT PLANS

In order to effectuate Policy #1, it is necessary to:

1. Develop an Airport Environs Land Use Compatibility Plan.
2. Adopt appropriate ordinances to implement the land use plan.
3. Restrict or prohibit incompatible land use.
4. Establish the standards of compatibility, and
5. Prevent the establishment of any land use which would endanger the continued use of the airport.

As discussed in the preceding section, there are land uses which can endanger aircraft operations. These uses must be specified and recognized as incompatible:

Policy #3

INCOMPATIBLE USES

Within the airport environs, there are certain land uses which are recognized as being incompatible. These land uses are not in the public interest and therefore must be restricted and/or prohibited:

1. Uses which release into the air any substance which would impair visibility or otherwise interfere with the operation of aircraft, such as but not limited to steam, dust and smoke.

2. Uses which produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.
3. Uses which produce electrical emissions which would interfere with aircraft communication systems or navigational equipment.
4. Uses which would attract birds or waterfowl, such as but not limited to dumping of garbage, maintenance of feeding stations, or the growing of certain vegetation.
5. Uses which extend into the air within ten feet of the approach-departure surface and/or transitional surfaces as set forth in Air Force Manual 86-8.
6. Uses which exceed a height of 150 feet above the runway elevation.

Certain noise levels and accident hazard potential must be recognized as incompatible with some land uses:

Policy #4

NOISE AND ACCIDENT HAZARD

It is recognized that certain noise levels of varying duration and frequency create hazards to both physical and mental health. It is further recognized that a definite danger to life exists in certain areas adjacent to airports. Where these conditions exist, it is not consistent with the public health, safety and welfare to allow the following land uses:

1. Residential
2. Retail Business
3. Office Buildings
4. Public Buildings
5. Recreation Buildings and Structures

Where significant accident potential exists, density and intensity of use standards should be drafted:

Policy #5

LAND USE DENSITY

Land areas below approach-departure flight paths are exposed to significant danger of aircraft accidents. It is, therefore, necessary to limit the density of development and the intensity of use.

All land uses have some sensitivity to noise. A system of noise sensitivity and construction attenuation should be recognized to allow development where it would otherwise be incompatible:

Policy #6

NOISE REDUCTION STANDARDS

It has been established that different land uses have different sensitivities to noise. Standards of acceptability should be adopted based on these noise sensitivities. In addition, a system of noise reduction standards for construction should be used to allow certain uses where they would otherwise be prohibited.

The planning process is not single purpose. It is comprehensive and includes all land use determinants. It follows that the evaluation of aircraft operations/land use compatibility is only a part of planning. Thus Policy #7:

Policy #7

TOTAL ENVIRONMENTAL PLANNING

It is recognized that land use planning and zoning in the airport environs cannot rest solely on airport impacts. Allocation of land uses within the airport environs should be further refined by analysis of:

1. Physiographic Factors
2. Climate and Hydrology

3. Vegetation
4. Surficial Geology
5. Soils Characteristics
6. Intrinsic Land Use Suitability
7. Economic and Social Demand
8. Land Ownership Patterns and Value
9. Existing Land Use
10. Cost and Availability of Public Utilities
11. Cost and Availability of Transportation
12. Cost and Availability of Community Facilities

The ten policies outlined above serve as the focal point for airport environs land use compatibility planning. Depending on the individual situation, policies should be modified, expanded or limited. Adaptation should be accomplished at the local level by local people. Policies may be incorporated into existing policy plans. In any event, such policies are extremely important. In terms of total implementation strategy, they should be presented to local policy makers at the beginning of the planning process. Such policies may be quite acceptable at first while specific details in an ordinance may not. Once the policies are accepted they serve as "notice to the world." The details can then follow.

DEFINING THE AIRPORT OPERATIONS "FOOTPRINT" BASIC DATA REQUIREMENTS

The airport operations "footprint" is the foundation of airport area land use compatibility planning. Before any planning can begin, the planner must know the exact nature of the aircraft operations. He must know such things as what kinds of aircraft use the airport, where they fly, how high they fly, how many times they fly over a given area and what time of day they operate. The planner must be able to accurately depict in words and graphic material the sum total of aircraft operations in the airport environs.

Operations data acquisition can be divided into several steps. The first requirement is to fully inventory the types of aircraft using the installation because each has a different "footprint." The second step is to accurately depict the flight patterns in the vicinity of the airport for each aircraft (Figure 3-1). In most cases, these patterns should be plotted on a 1"=2000' USGS map with a radius of approximately five to eight miles. Most civil airports have relatively simple flight patterns, at least compared to those at military airfields. Most civil aviation patterns are essentially straight-in and straight-out. Figure 3-1 shows one of the more complicated pattern arrangements used by the military; that of the training base using T-37 and T-38 aircraft. Similar patterns can be found at civil airports with National Guard or Reserve units.

The complex example in Figure 3-1 has five basic patterns:

1. Straight Out Takeoff
2. Straight In Landing
3. Overhead Landing
4. Closed Pattern to the Inside Downwind
5. Closed (Crosswind) Pattern to the Outside Downwind

Step three in this process is the plotting of profiles for each aircraft on each pattern (Figure 3-2). This information is vital because noise exposure is a function of aircraft altitude. It is readily apparent that flight profiles differ considerably by aircraft and pattern.

The depiction of flight patterns and profiles requires a certain degree of judgment. Flight patterns are variable. They are not stable like highways. In some cases, it is advisable to establish ranges of variation based on accurate data. In spite of this variation, it is necessary to establish a single flight path to serve as the basis for

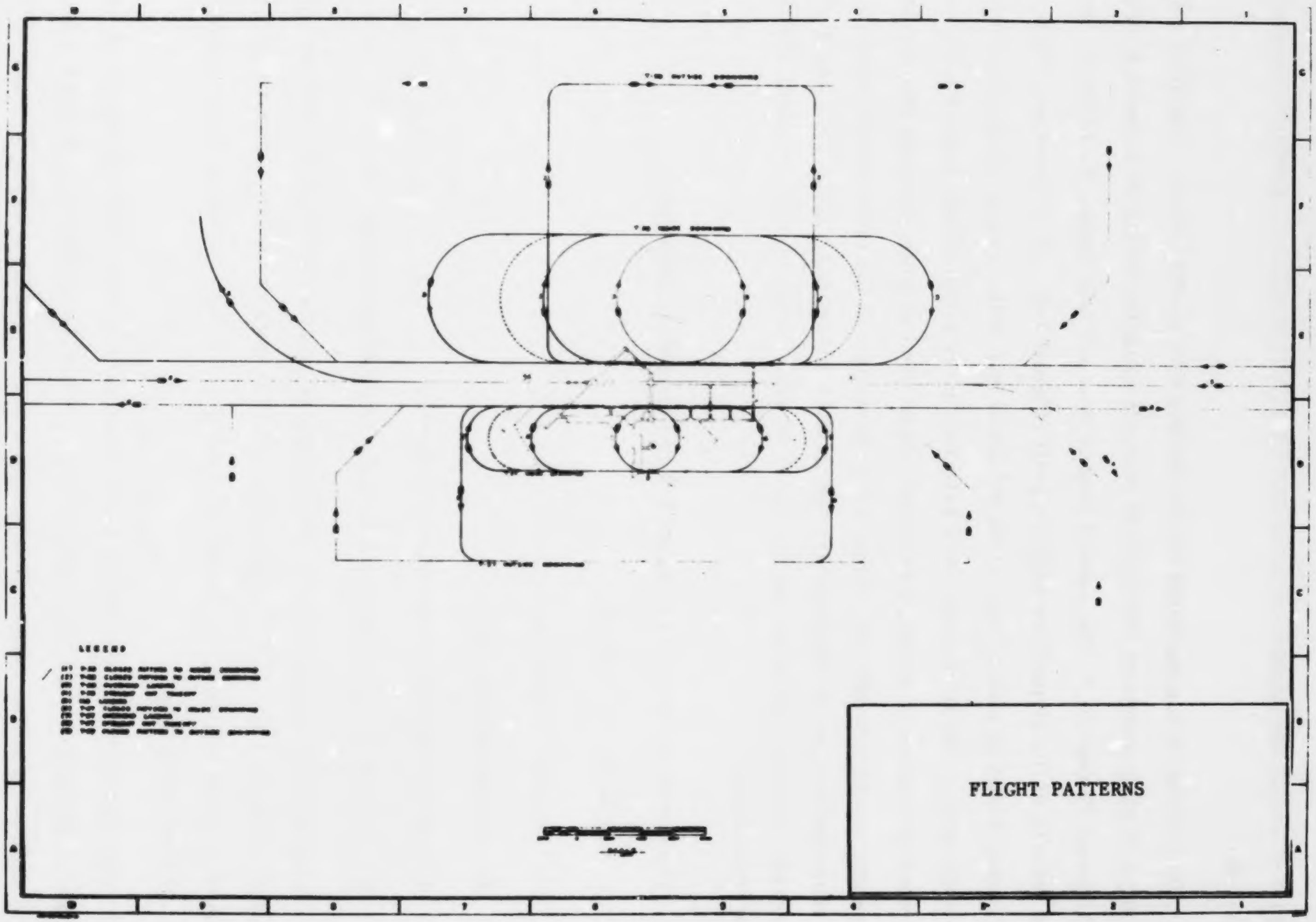

FLIGHT PATTERNS

Figure 3-1. Flight Patterns

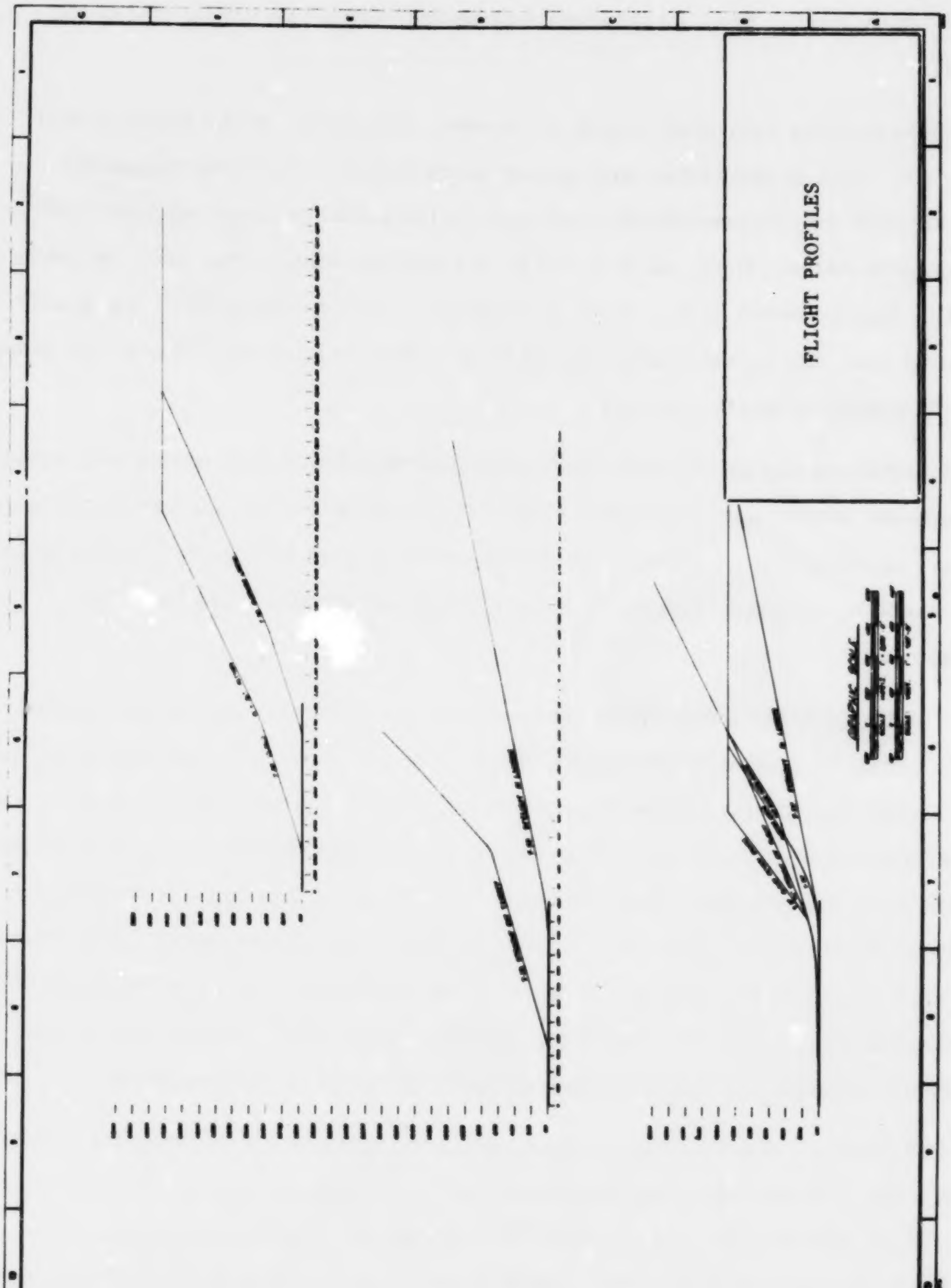


Figure 3-2. Flight Profiles

noise contour work. The line selected may be that which has 50% or 75% of the flights.

Flight profiles vary from season to season. Generally, in the summer heat they are lower, while in the winter they may be much higher. Variation ranges for the same aircraft may be considerably different in the northern states as compared to the southern states. Here, as in the case of flight patterns, a line must be selected. Selection may be based on the worst (lowest), average or best (highest) situation. As a general rule, the lowest profile should be selected, particularly where it is flown more than several months per year.

Both pattern and profile depictions should be based on actual operations rather than manufacturers' specifications or other "theoretical" data. As was stated previously, operations for a given aircraft vary from airport to airport. Where there are planned operational changes such information should also be plotted and considered.

With the patterns and profiles finalized, it is possible to compile operational data in terms of number of flights, frequency, etc. Data must be tabulated on a daily and yearly basis for each pattern and aircraft. For instance, the total daily number of overhead landings on Runway 30 (assumes all landings during one day are on Runway 30) must be specified. The amount of time during a year that the overhead pattern to Runway 30 is used must be specified by a percentage figure. Since there are three other landing patterns on this runway (overhead, RW 12, straight-in RW 30 and straight-in RW 12), the sum of all four must equal 100%. In the case of the Figure 3-1 example, 20 different operational patterns must be considered.

The planning of the airport environs must recognize accident potential. Concern for this factor historically has focused on approach-departure zones as the critical areas of paramount importance. It is obvious that the Figure 3-1 example does not jibe with the traditional view. Use of these traditional potential hazard zones for civil airports is also questionable. What is needed is a measurement technique that more precisely depicts and analyzes the actual critical accident hazard areas.

It should be noted that such a technique will not replace the system of zones currently used for obstruction and height zoning. That system is good for what is was designed to do. The new technique will be used to determine land use compatibility based on hazard to the land use rather than hazard to operations from land uses.

The logical way to evaluate accident hazard is to plot and evaluate past accidents. In the case of the Figure 3-1 example, histories of T-37 and T-38 accidents at all installations using these aircraft were assembled for the period 1961 to present. As a further refinement, these accidents were plotted by the pattern being flown at the time of the crash. The results were enlightening in the sense that they did not support the use of the conventional approach-departure zones.

At airports where there are many types of aircraft in use, accident plotting is more complex. Some airports and aircraft have excellent safety records and, as a result, there is little upon which to base an analysis. In no case should the accident sample be based only on the history of one airport. On the other hand, the sample should not be based on all accidents of all aircraft at all airports. The sample, in order to be valid, should be confined to all accidents, at all airports where the same type of aircraft are being flown as are in use, or projected to be used, at the subject airport.

Closely related to the accident plot is the summarization of flight characteristics. Aircraft differ operationally in that certain portions of flight are more hazardous than others. Factors such as glide characteristics and the results of system malfunctions must be known. For instance, the glide characteristics of the T-38 are very poor compared to those of the T-37. The T-38 also flies at greater speeds. This means that the T-38 comes down much faster. If a problem develops which necessitates the ejection of the pilot in a T-38, little can be done to direct the aircraft to an open area. The T-37 moves much slower, glides farther and can be directed to some degree.

Other flight characteristic considerations include the fact that hydraulic failure in a T-38 or the ingestion of birds in both engines almost certainly means an accident.

These factors do not exist with the T-37. It is also known that one of the most critical portions of a T-38 flight is during the final turn.

Obviously, a thorough knowledge of flight characteristics, together with accident histories, reconstituted as disaster potential impact zones surpasses the older method of simply designating runway ends as the sole hazard areas. Utilization of this data is explained below.

The preceding discussion of data acquisition has dealt exclusively with the existing situation. Airport operations, like all things, change. Therefore, the data acquisition phase must include a projection of the future. For civil airports' projections in terms of future aircraft and daily usage are usually available. If the acquisition of a new aircraft is being projected, its patterns and profiles should be plotted, based on the best available information. Operational data, such as daily flight numbers and pattern utilization, can also be assembled. For land use planning purposes such projections should be treated as though they exist today.

Military airports pose a somewhat different problem. Future projections are not based on anticipated passenger demand. They are sometimes based on total mission changes which are often in the form of classified information. Where future mission changes are known, data should be assembled for that mission. In cases where a new aircraft is projected for a certain installation it should be considered in the same manner. In other cases, the potentiality of mission changes should be considered so that an installation's short range land use plan does not obsolete the installation for future use. Such data, as in the case of the civil airport, should be treated as valid for land use planning purposes.

THE NOISE "FOOTPRINT"

Noise is the most bothersome airport problem today because noise causes people to react against the airport. The description, depiction and evaluation of noise due to aircraft operations is by far the least resolved factor in airport planning. At present, there are at least ten aircraft noise systems being used in the world. Four of these (CNR, NEF, CNEL and db(A)) are used in the United States.

Composite Noise Rating (CNR) has been in use since the early 1960's. The essence of the CNR system is the expression of aircraft noise in terms of perceived noise level (PNL) in perceived noise decibels (PNdB) at any given distances from the noise source. PNL contours are drawn to correspond to flight paths and profiles. The PNL contours are then converted to CNR by applying corrections for the number of operations, etc.[30]

The Noise Exposure Forecast (NEF) system is a refinement of the CNR system which uses EPNL (Effective Perceived Noise Level) rather than PNL as the basic noise contours.[31] Major advances over CNR include tone correction, duration correction and computerization.[32]

The State of California uses a system called the Community Noise Equivalent Level (CNEL). This system, based on actual monitoring, uses decibels (db) as the basic measure.[33] It, like CNR and NEF, includes such elements as noise level of separate events, the number of noise events in some specified time period and normalizing constants.[34]

The db(A) system is used by the U. S. Department of Housing and Urban Development (HUD) for purposes of the FHA Mortgage Insurance Program.[35] HUD also uses CNR or NEF. Use of db(A) (decibels on the A scale) requires simple on-scene measurement. Such measurements are then expressed by the amount of exposure.

Composite Noise Rating has been the most widely used system although it is now being replaced by Noise Exposure Forecast. In a recent study by Bolt, Beranek, and Newman for the United States Air Force, BB and N recommended:

> "The USAF aircraft noise-land use planning procedure should employ EPNL (NEF) as the measure for specifying noise from aircraft."[36]

For immediate purposes either CNR or NEF must be used. NEF is a better system although properly constructed CNR controus can be used. The methodology developed in this section can employ either system or could be used with any new comparable system.

Figure VI-1-3 is a Composite Noise Rating contour map for the Figure 3-1 example. CNR and NEF maps usually have only two noise contour lines: CNR 100 or NEF 30 and CNR 115 or NEF 40. These lines create three zones. CNR Zone 3 or NEF Zone C is within the CNR 115 or NEF 40 line. CNR Zone 2 or NEF B is between CNR 100 and CNR 115 or NEF 30 and NEF 40. Areas outside CNR 100 or NEF 30 are considered as CNR Zone 1 or NEF Zone A. Use of these zones has generally focused on residential acceptability which is based on levels of anticipated community response. HUD's use of this system denies mortgage insurance in CNR Zone 3 or NEF Zone C and considers CNR Zone 2 or NEF B as normally unacceptable.[37]

The Figure 3-3 CNR map has four lines: CNR 122.5, 115, 107.5 and 100. These lines correspond to NEF 45, 40, 35 and 30 respectively. These CNR lines were used for three reasons:

1. They offer more land use options
2. They correspond to the NEF system
3. They correspond to most of the land use studies which use the NEF system.

Drawing a valid CNR noise contour map is a very complex, time consuming process. It is quite easy to consume 200-400 manhours on a really complicated CNR map. There are actually two ways to draw a CNR map. The first involves selecting predrawn PNL contours for the group of aircraft in which the subject aircraft is classified, applying operational corrections and connecting the lines. This method, however, does not produce a valid, accurate CNR map.

The first problem is that aircraft are grouped in terms of noise output. This grouping concept says that the T-37 makes the same amount of noise that a T-38 produces. This is simply not true. Secondly, the grouping procedure assumes that both aircraft have the same landing and takeoff flight profiles. As shown in Figure 3-2 there is wide flight profile variation even for the same aircraft. A third problem is the total inability of applying the predrawn contours to any pattern other than a straight-in landing or straight-out takeoff. Use of the predrawn method is totally unacceptable for purposes of compatible land use planning.

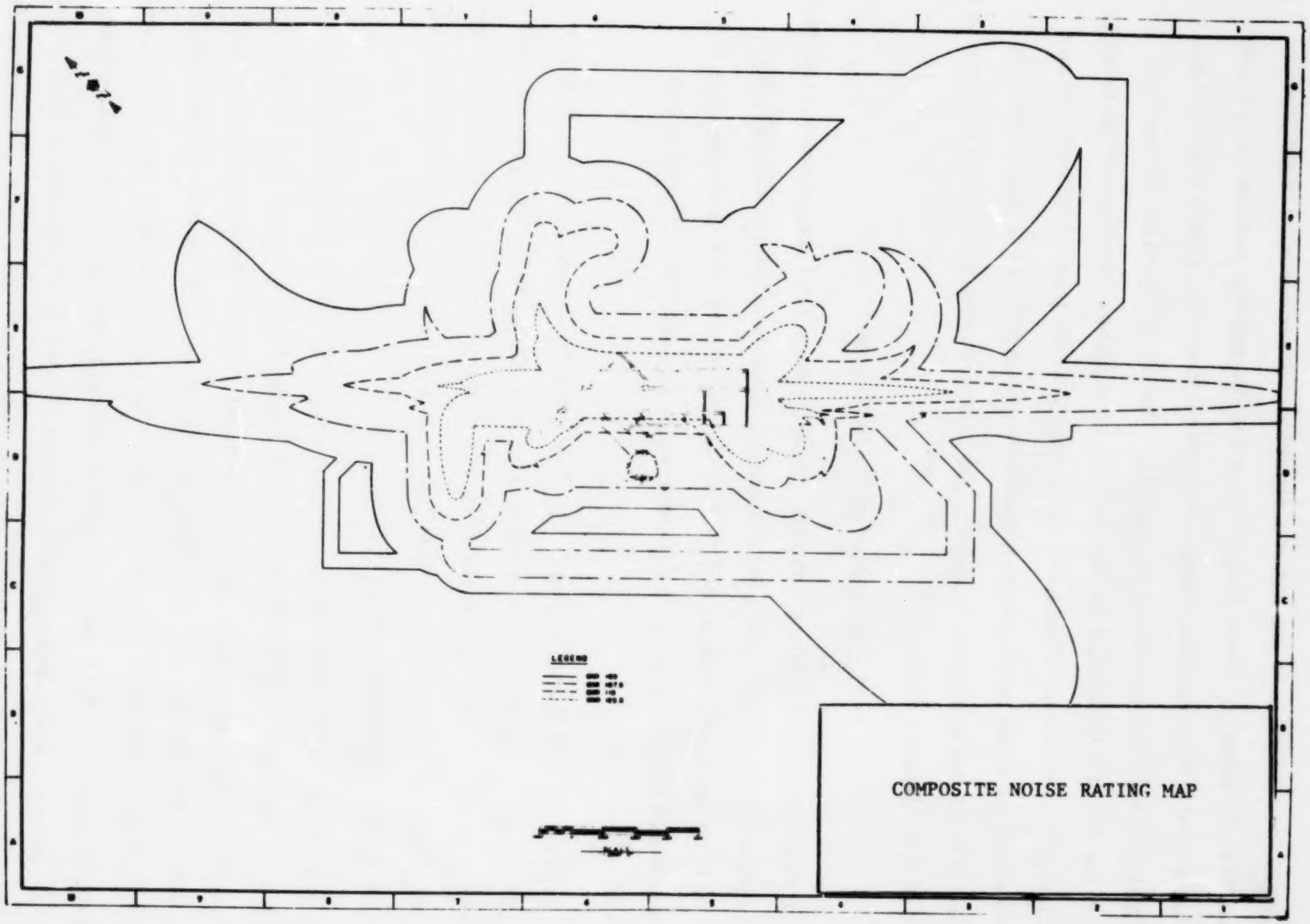

COMPOSITE NOISE RATING MAP
LEGEND

Figure 3-3. Composite Noise Rating Map

The proper procedure is to construct a separate contour for each flight profile (on each flight path) using the noise output figure for the specific aircraft at the power settings being used. This method simply requires plotting PNL points laterally along a given flight path and then connecting the points. One must visualize the aircraft traveling at the top of a triangle. As the aircraft goes higher, the base of the triangle gets smaller until it disappears entirely. Since the altitude (side of triangle) at any given point along the flight path and the noise exposure in PNL at a given distance (hypotenuse of triangle) is known, it is a simple matter to plot the points by determining the length of the triangle's base.

The Accident Hazard "Footprint"

The present method of plotting aircraft accidents does not support the use of conventional approach-departure zones for compatible land use planning although the standard obstruction type zoning is still valid. In the Figure 3-1 example, use of these zones would miss certain critical areas while including other large areas unnecessarily.

The problem is to accurately depict accident hazards in zonal terms. Simply plotting accidents is not the complete solution as was shown in the analysis of operational characteristics. Throughout the litigation history of airports, the courts have consistently used the altitude of the overflight as a basis for decisions. Altitudes of 500 and 100 feet above ground level (AGL) have been cited frequently.

For the Figure 1-1 airport, all areas below flight paths of less than 200 feet AGL, 200-500 feet AGL and 500-1000 feet AGL extending 500 to 1000 feet laterally were designated by the delineation of three accident zones at the ends of each runway (Figure 3-4). The accident plot was then overlayed on each runway to determine how many aircraft would have impacted in each area, assuming they had all occurred at the subject airport. The results were approximately 30% in Zone 1, 20% in Zone 2 and 10% in Zone 3. Thirty percent would have occurred on or adjacent to the runways. Of all the accidents, only 10% would have occurred outside the airport boundaries and the three zones.

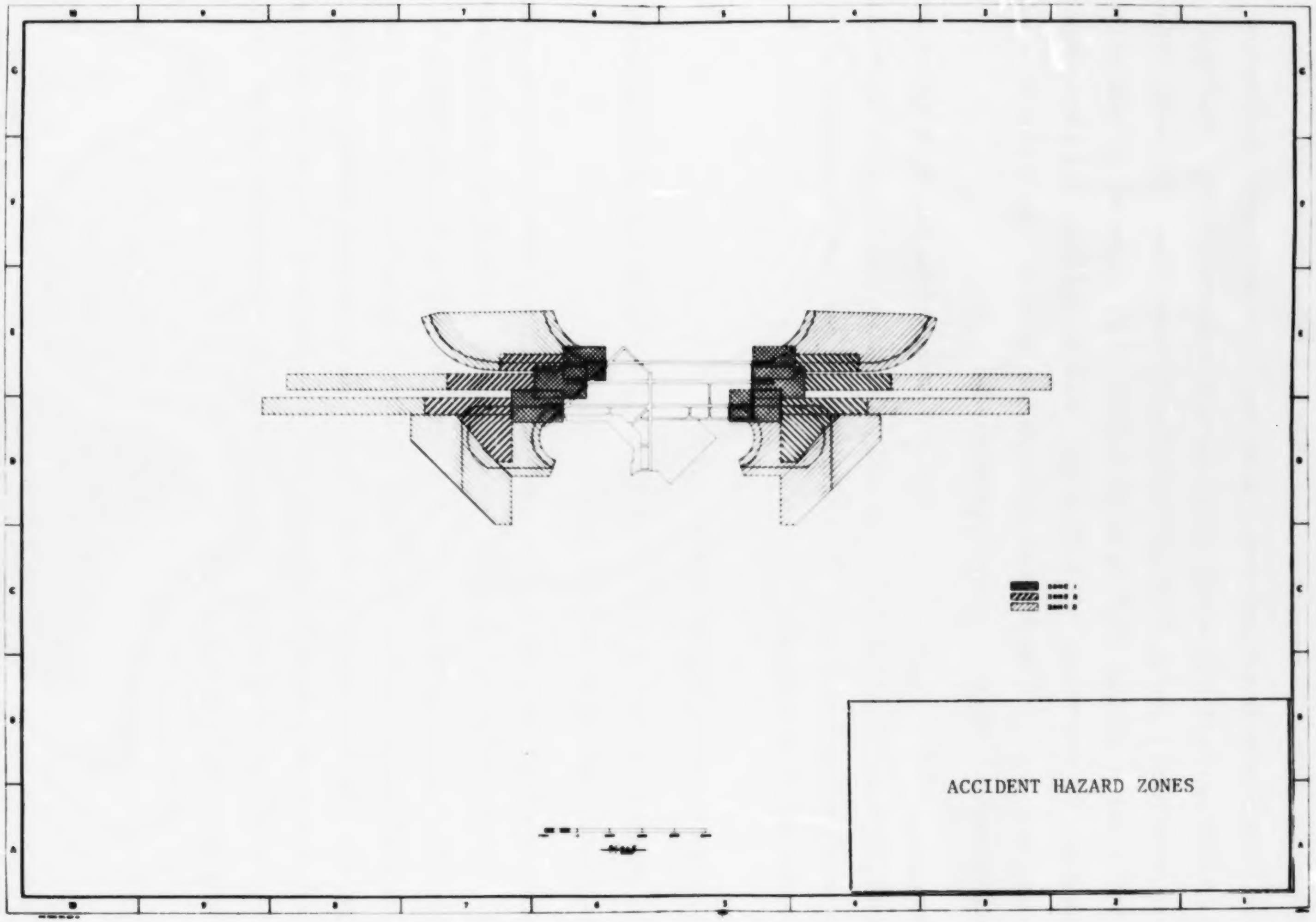

ACCIDENT HAZARD ZONES

Figure 3-4. Accident Hazard Zones

Within this general framework it is possible to develop standards of land use based on accident occurrence and area. In any case, the above described method offers a better approach than simply using approach-departure zones. The three accident zones were based on T-37 and T-38 aircraft operations. The width of the zones was based on the size of the area where debris was scattered, as well as the accident plot. Other aircraft, because of size, accident histories and performance characteristics, will produce different accident hazard zones. For example, a 1000-foot wide corridor is not necessarily appropriate for a 747.

If an airport has many types of aircraft or if there is a projected change of aircraft type, such factors should be considered. The actual delineation of these zones for a given installation will, to a large degree, be the result of professional judgment by planners and aviation experts.

THE AIRCRAFT OPERATIONS "FOOTPRINT"

The planner now has a detailed package of operational factors which are expressed through a noise map and an accident hazard map.

These two maps, drawing on the composite operational factors, form the framework for compatible land use planning. The noise map generally establishes the outer boundary of the airport planning area. It is comprehensive in the sense that it includes all areas significantly impacted or affected by aircraft operations. In airport land use planning, it is generally accepted that all land areas within CNR Zones 2 and 3 or NEF B and C are impacted and should be regulated to some degree. The Accident Hazard Zones fall within the noise zones. These two maps are combined to produce the Airport Environs Land Use Compatibility Plan.

THE AIRPORT ENVIRONS LAND USE COMPATIBILITY PLAN

The Airport Environs Land Use Compatibility Plan (Figure 3-5) includes land areas upon which certain land uses may obstruct the airspace or otherwise be hazardous to aircraft operations and/or land areas which are exposed to the health and safety hazards of aircraft operations.

The plan itself is the result of overlaying the noise and accident zone maps and combining the four noise and three accident zones. The plan for the Figure 3-1 example is comprised of ten Compatible Use Districts (CUD). The number and character of these districts will vary depending on the airport in question. The districts are:

CUD 1. Areas below flight paths of less than 200 feet altitude extending 1000 feet laterally.

CUD 2. Areas below flight paths of 200 to 500 feet altitude extending 500 feet laterally within CNR Zone 122.5+ or NEF Zone 45+.

CUD 3. Areas below flight paths of 200 to 500 feet altitude extending 500 feet laterally within CNR Zone 115 to 122.4 or NEF Zone 40 to 44.9.

CUD 4. Areas below flight paths of 500 to 1000 feet altitude extending 500 feet laterally within CNR Zone 115 to 122.4 or NEF Zone 40 to 44.9.

CUD 5. Areas within CNR Zone 122.5+ or NEF Zone 45+.

CUD 6. Areas within CNR Zone 115 to 122.4 or NEF Zone 40 to 44.9.

CUD 7. Areas below flight paths of 500 to 1000 feet altitude extending 500 feet laterally within CNR Zone 107.5 to 114.9 or NEF Zone 35 to 39.9

CUD 8. Areas below flight paths of 500 to 1000 feet altitude extending 500 feet laterally within CNR Zone 100-107.4 or NEF Zone 30-34.9.

CUD 9. Areas within CNR Zone 107.5 to 114.9 or NEF Zone 35 to 39.9.

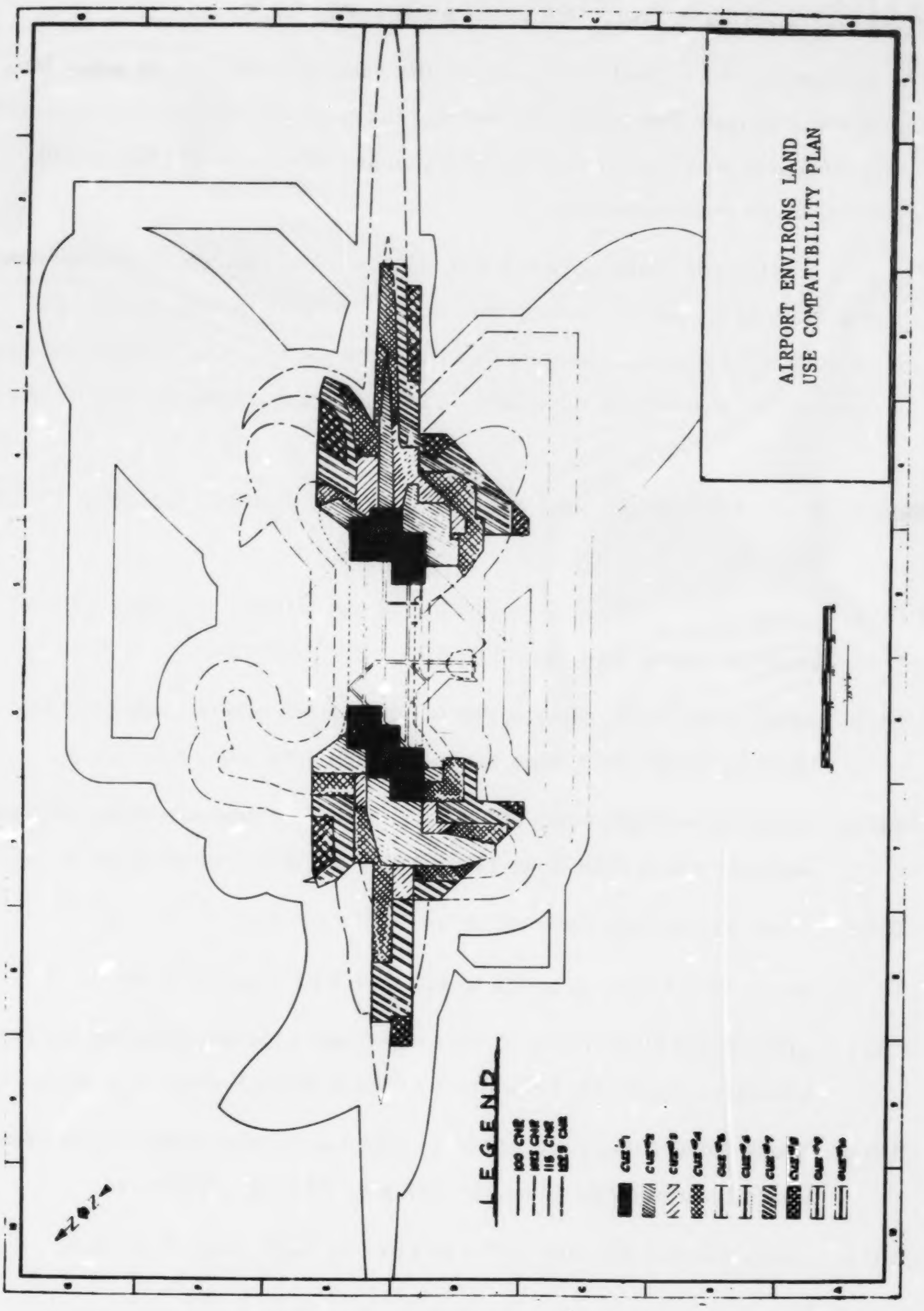

AIRPORT ENVIRONS LAND USE COMPATIBILITY PLAN
LEGEND
100 CNR
115 CNR
CUZ #1
CUZ #2
CUZ #3
CUZ #4
CUZ #5
CUZ #6
CUZ #7
CUZ #8
CUZ #9
CUZ #10

Figure 3-5. Airport Environs Land Use Compatibility Plan

CUD 10. Areas within CNR Zone 100 to 107.4 or NEF 30-34.9.

The Compatible Use Districts exist in order to provide a means by which realistic land use decisions can be made. It is obvious that one large undifferentiated area and one set of land use standards would be impractical and unreasonable, particularly where development pressure is intense.

The Compatible Use District combines all aircraft operational land use impacts. It is a means by which the sum total of noise, accident potential and other factors may be brought to bear on land use decision-making. It is multi-impact compared to single impact noise planning and zoning.

LAND USE COMPATIBILITY STANDARDS

The essence of the land planning process is the land use standard. It is, at this point, that the planner must stop to ask some crucial zoning test questions concerning the land use plan and future zoning implementation:

1. Is it reasonable?
2. Is it arbitrary?
3. Does it promote and protect the general health, safety and welfare?

If the plan fails on any one of these points, it will not accomplish the desired goals. Although there are other tests, the above are the most critical.

Is the system reasonable? It is here that serious thought and analysis must be given to exactly what must be accomplished. How much protection from what impacts is necessary? What and where is compatible land use? How much land does the system render economically useless? If the system destroys economic utility, this can constitute "taking without due compensation." The point of the reasonableness test is to keep restrictions at the absolute minimum while accomplishing the desired result. This requires detailed, rational, documented analysis.

Is the system arbitrary? What is the basis for the zoning district boundaries? What is the basis for the land use restrictions in each zoning district? The arbitrary test requires that zoning actions must have a rational, identifiable basis.

Does the land use system promote and protect the general health, safety, and welfare? With reference to noise, does the system protect the people from health hazards? Does the system protect the people from a recognized danger of aircraft accidents? Is the general welfare advanced?

Development of land use standards can be divided into two parts: the determination of compatibility with noise and of compatibility with accident potential. The separate sets of standards can then be combined to correspond with the ten compatible use districts.

Compatibility with noise has been the subject of many studies. It is generally agreed by the noise experts that some land uses are simply not compatible at certain high noise levels, whereas other uses are compatible with no restrictions at the same noise levels. A large number of uses are compatible if certain noise reduction considerations are incorporated into the construction criteria.

Noise compatibility standards are based on factors such as:

"1. Speech communication needs

2. Subjective judgments of noise acceptability and relative noisiness

3. Need for freedom from noise intrusions

4. Sleep sensitivity criteria

5. Accumulated case histories of noise complaint experience near civil and military airports, and

6. Typical noise insulation provided by common types of building construction."[38]

The noise/land use compatibility standards used with the Compatible Use Districts are mostly based on the results of a Bolt, Beranek and Newman Study entitled, Noise Exposure Forecasts: Evolution, Evaluation, Extensions and Land Use Interpretations. This study classified a number of land uses in terms of compatibility, non-compatibility and marginal compatibility requiring special consideration. Using this study plus a number of other sources,[39] a system of compatibility using Noise Reduction Factors was designed.

The basis of the Noise Reduction Factor System is the upper noise level expressed in CNR at which a given land use is outright compatible. Beyond that point up to a higher cutoff level, the use is conditionally acceptable. The difference between the two noise levels constitutes the range of noise reduction. For instance, if a use is acceptable with no limitations at CNR 110, CNR 110 is the zero point. If a structure is proposed for a location at CNR 117, the Noise Reduction Factor is 7. If the use is conditionally acceptable only between CNR 110 and CNR 117.5, the Noise Reduction Factor for that use ranges between 0 and 7.5. Beyond CNR 117.5 the use is not compatible.

Determination of what constitutes the required noise reduction is accomplished through conventional standards of noise transmission through given substances, planting and other barrier construction and siting considerations. Liberal zoning provisions for specific site analysis, as well as procedures for verification by architects and acoustical engineers that the standard has been met, are part of the system.

Land use standards for the three accident zones are primarily expressed in terms of non-compatibility and compatibility with density and intensity of use criteria. Certain uses such as those which concentrate large numbers of people are clearly not compatible in hazard areas. Other uses, such as industrial, are limited in terms of lot coverage to allow open spaces in critical areas. These standards are the composite of the studies referenced above plus an analysis of accident occurrence vs. area.

This analysis focuses on five land areas: the three accident zones, on or adjacent to the runways (2000 feet wide) and all other areas within a six-mile radius. The percentage of the total accidents and area for each of the above are calculated. An accident vs Area Ratio of the percent total accidents to the percent total area for each zone is then developed, $\frac{\text{(Percent total accidents)}}{\text{(Percent total area)}}$.

There is an established land use standard for areas on or adjacent to the runways; that of no buildings, structures or habitation. Using the Accident vs Area Ratio for on or adjacent to the runways as the base, the Land Use Hazard Index $\frac{\text{(Accident Zone 1, etc)}}{\text{(on or adjacent to runway)}}$ is expressed. The Land Use Hazard Index is then converted into the Aircraft Hazard Acceptability Index (100-LUHI) which ranges from 0 to 100, with on or adjacent to runways equaling 0 and all other areas within six mile radius equaling approximately 98 or 99.

The Aircraft Hazard Acceptability Index (AHAI) is the basic guide to determine the allocation of various land uses in the airport environs. Land use standards are known for on or adjacent to runways (total prohibition of structures) and all other areas within a six mile radius (no restrictions). Between these two extremes are the three accident zones. Using the AHAI's for each zone and existing land use recommendations, it is then simply a matter of equating land use compatibility to AHAI's (see Land Use Compatibility Chart).

With the basic compatibility question resolved it is necessary to develop density and intensity of use standards. Such standards are based primarily on the size and shape of accident impact areas, although the AHAI is also considered. Basic data includes the percent of the total accident zone impacted by a single crash and the percent of the total accident zone impacted by all crashes. Using a maximum 0.2% chance of a single building being impacted by some debris from a crash, lot size and lot coverage standards are written. For residential uses a minimum of 75% open space is required.

The combined system of land use compatibility for the ten compatible use districts depicted in Figure 3-5 is shown in Figure 3-6.

Compatible Use District 1 has the highest accident potential, plus noise levels almost always exceed CNR 115 (Zone 3) or NEF 40 (Zone C). CUD 1, therefore, is subject to the most severe land use restrictions. Uses are essentially limited to agriculture and open space.

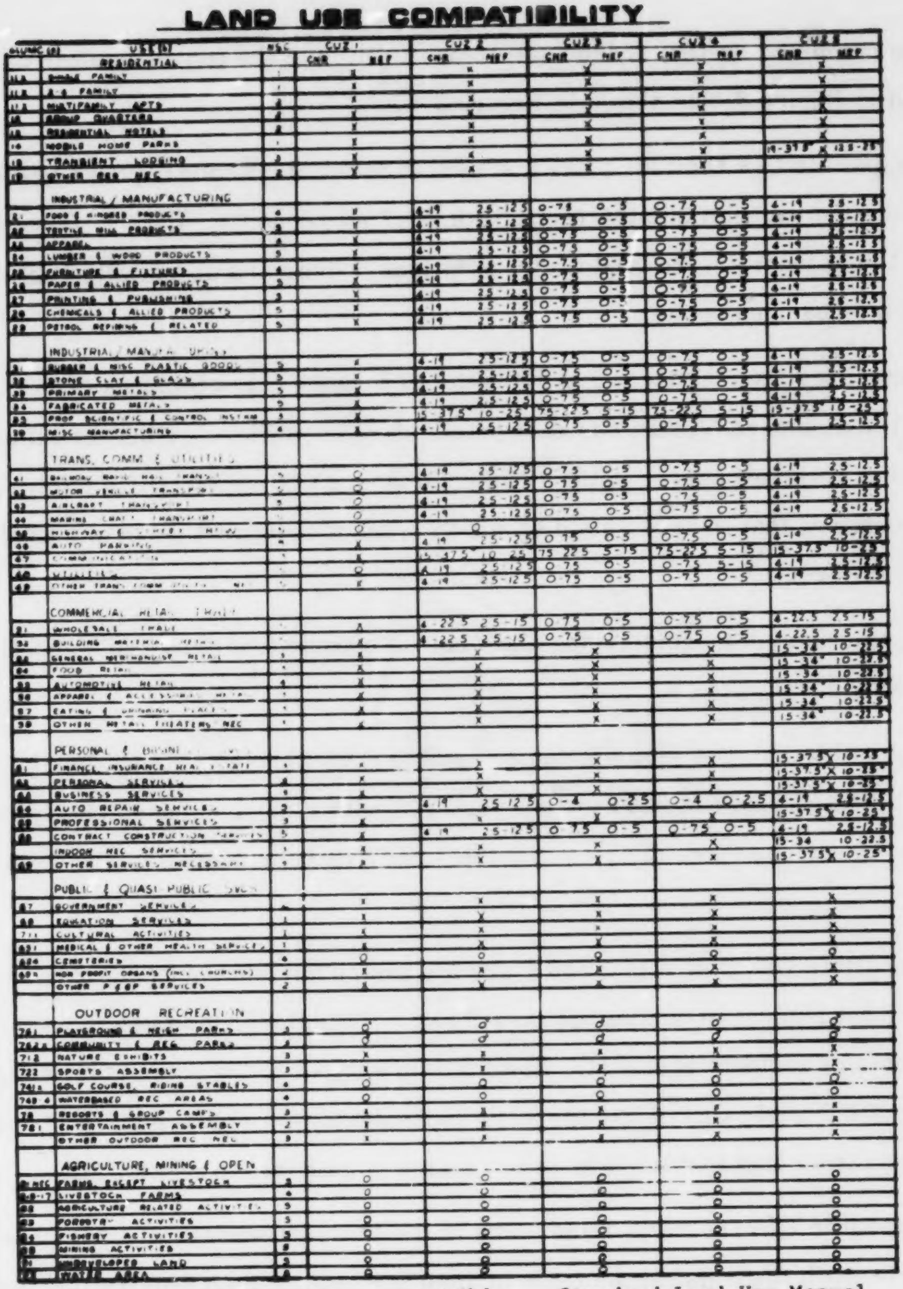
Compatible Use Districts 2 and 3 both fall beneath flight patterns of 200 to 500 feet AGL (the second highest accident potential). The difference between them is the level of noise exposure. CUD 2 has noise above CNR 122.5 (NEF 45) while CUD 3 has noise below that level. This distinction is made because the noise reduction factors are different.

Most industrial/manufacturing and wholesale trade functions are compatible in CUD's 2 and 3.

Compatible Use District 4 is the remaining CNR Zone 3 (NEF C) district subject to overflights; in this case 500 to 1000 feet AGL altitude. Land use density is higher than in the previous three districts but the standards based on noise are the same as CUD 3.

Compatible Use Districts 5 and 6 are the two subdivisions of CNR Zone 3 (NEF C) which are not subject to continuous overflights. Therefore, land use is not restricted on the basis of accident potential. District 5 is subject to the same noise restrictions found in CUD 2 while CUD 6 has the same noise standards found in CUDs 3 and 4. Most retail trade and service land uses become compatible in these CUDs.

Compatible Use Districts 7 and 8 are in the two subdivisions of CNR Zone 2 (NEF B) beneath flight patterns of 500 to 1000 feet AGL. Both require the land use and density regulations found in CUD 4. Land use regulation based on noise is more permissive than in the previous districts because the exposure is lower.



LAND USE COMPATIBILITY

SLUCM (a)	USE (b)	NSC	CUZ 1 CNR	CUZ 1 NEF	CUZ 2 CNR	CUZ 2 NEF	CUZ 3 CNR	CUZ 3 NEF	CUZ 4 CNR	CUZ 4 NEF	CUZ 5 CNR	CUZ 5 NEF
	RESIDENTIAL											
111	SINGLE FAMILY	1	X		X		X		X		X	
112	2-4 FAMILY	1	X		X		X		X		X	
113	MULTIFAMILY APTS	2	X		X		X		X		X	
12	GROUP QUARTERS	2	X		X		X		X		X	
13	RESIDENTIAL HOTELS	2	X		X		X		X		X	
14	MOBILE HOME PARKS	1	X		X		X		X		15-37.5"	X 12.5-25"
15	TRANSIENT LODGING	3	X		X		X		X		X	
19	OTHER RES NEC	2	X		X		X		X		X	
	INDUSTRIAL / MANUFACTURING											
21	FOOD & KINDRED PRODUCTS	4	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
22	TEXTILE MILL PRODUCTS	3	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
23	APPAREL	4	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
24	LUMBER & WOOD PRODUCTS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
25	FURNITURE & FIXTURES	4	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
26	PAPER & ALLIED PRODUCTS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
27	PRINTING & PUBLISHING	3	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
28	CHEMICALS & ALLIED PRODUCTS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
29	PETROL REFINING & RELATED	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
	INDUSTRIAL / MANUFACTURING											
31	RUBBER & MISC PLASTIC GOODS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
32	STONE CLAY & GLASS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
33	PRIMARY METALS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
34	FABRICATED METALS	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
35	PROF SCIENTIFIC & CONTROL INSTRM	3	X		15-37.5"	10-25"	7.5-22.5	5-15	7.5-22.5	5-15	15-37.5"	10-25"
39	MISC MANUFACTURING	4	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
	TRANS, COMM & UTILITIES											
41	RAILROAD RAPID RAIL TRANSIT	5	O		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
42	MOTOR VEHICLE TRANSPORT	5	O		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
43	AIRCRAFT TRANSPORT	5	O		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
44	MARINE CRAFT TRANSPORT	[illegible]	O		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
45	HIGHWAY & STREET R/W	5	O		O		O		O		O	
46	AUTO PARKING	4	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
47	COMMUNICATION	[illegible]	X		15-37.5"	10-25	7.5-22.5	5-15	7.5-22.5	5-15	15-37.5	10-25"
48	UTILITIES	[illegible]	O		4-19	2.5-12.5	0-7.5	0-5	0-7.5	5-15	4-19	2.5-12.5
49	OTHER TRANS COMM UTILITIES NEC	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
	COMMERCIAL RETAIL TRADE											
51	WHOLESALE TRADE	[illegible]	X		4-22.5	2.5-15	0-7.5	0-5	0-7.5	0-5	4-22.5	2.5-15
52	BUILDING MATERIAL RETAIL	[illegible]	X		4-22.5	2.5-15	0-7.5	0-5	0-7.5	0-5	4-22.5	2.5-15
53	GENERAL MERCHANDISE RETAIL	3	X		X		X		X		15-34"	10-22.5
54	FOOD RETAIL	[illegible]	X		X		X		X		15-34"	10-22.5
55	AUTOMOTIVE RETAIL	4	X		X		X		X		15-34	10-22.5
56	APPAREL & ACCESSORIES RETAIL	[illegible]	X		X		X		X		15-34"	10-22.5
57	EATING & DRINKING PLACES	[illegible]	X		X		X		X		15-34"	10-22.5
59	OTHER RETAIL THEATERS NEC	[illegible]	X		X		X		X		15-34"	10-22.5
	PERSONAL & BUSINESS SERVICES											
61	FINANCE INSURANCE REAL ESTATE	[illegible]	X		X		X		X		15-37.5"	X 10-25"
62	PERSONAL SERVICES	4	X		X		X		X		15-37.5"	X 10-25"
63	BUSINESS SERVICES	[illegible]	X		X		X		X		15-37.5"	X 10-25"
64	AUTO REPAIR SERVICES	2	X		4-19	2.5-12.5	0-4	0-2.5	0-4	0-2.5	4-19	2.5-12.5
65	PROFESSIONAL SERVICES	3	X		X		X		X		15-37.5"	X 10-25"
66	CONTRACT CONSTRUCTION SERVICES	5	X		4-19	2.5-12.5	0-7.5	0-5	0-7.5	0-5	4-19	2.5-12.5
	INDOOR REC SERVICES	1	X		X		X		X		15-34	10-22.5
69	OTHER SERVICES NECESSARY	[illegible]	X		X		X		X		15-37.5	X 10-25"
	PUBLIC & QUASI PUBLIC SVCS											
67	GOVERNMENT SERVICES	[illegible]	X		X		X		X		X	
68	EDUCATION SERVICES	1	X		X		X		X		X	
711	CULTURAL ACTIVITIES	1	X		X		X		X		X	
651	MEDICAL & OTHER HEALTH SERVICES	1	X		X		X		X		X	
624	CEMETERIES	4	O		O		O		O		O	
691	NON PROFIT ORGANS (INCL CHURCHES)	2	X		X		X		X		X	
	OTHER P & QP SERVICES	2	X		X		X		X		X	
	OUTDOOR RECREATION											
761	PLAYGROUND & NEIGH PARKS	3	O		O		O		O		O	
762a	COMMUNITY & REG PARKS	3	O		O		O		O		O	
712	NATURE EXHIBITS	3	X		X		X		X		X	
722	SPORTS ASSEMBLY	3	X		X		X		X		X	
741a	GOLF COURSE, RIDING STABLES	4	O		O		O		O		O	
743-4	WATERBASED REC AREAS	4	O		O		O		O		O	
75	RESORTS & GROUP CAMPS	3	X		X		X		X		X	
721	ENTERTAINMENT ASSEMBLY	2	X		X		X		X		X	
	OTHER OUTDOOR REC NEC	3	X		X		X		X		X	
	AGRICULTURE, MINING & OPEN											
81 NEC	FARMS, EXCEPT LIVESTOCK	3	O		O		O		O		O	
815-17	LIVESTOCK FARMS	4	O		O		O		O		O	
82	AGRICULTURE RELATED ACTIVITIES	5	O		O		O		O		O	
83	FORESTRY ACTIVITIES	5	O		O		O		O		O	
84	FISHERY ACTIVITIES	5	O		O		O		O		O	
85	MINING ACTIVITIES	[illegible]	O		O		O		O		O	
91	UNDEVELOPED LAND	3	O		O		O		O		O	
93	WATER AREA	[illegible]	O		O		O		O		O	

O-Land use and structures compatible

X-Land use and structures not compatible

Numbers-Land use compatible and structure noise reduction required to the degree indicated.

a-Standard Land Use Manual Code

b-Noise Sensitivity Code

1-Use only/no buildings
2-Open space only
3-Low intensity
4-Airport related only

Figure 3-6. Airport Environs Land Use Compatibility Plan.

LAND USE COMPATIBILITY

SLUM a	USES	NSC b	CUZ 6		CUZ 7		CUZ A		CUZ 8		CUZ 10	
	RESIDENTIAL		CNR	NEF	CNR	NEF	CNR	NEF	CNR	NEF	CNR	NEF
11a	SINGLE FAMILY	1	X		7.5-15	5-10	1-7.5	1-5	7.5-15	5-10	1-7.5	1-5
11b	2-4 FAMILY	1	X		X		X		7.5-15	5-10	1-7.5	1-5
11c	MULTIFAMILY APTS	2	11.5-22.5 X	7.5-15	X		X		4-15	2.5-10	0-7.5	0-5
12	GROUP QUARTERS	2	X		X		X		4-15	2.5-10	0-7.5	0-5
13	RESIDENTIAL HOTELS	2	X		X		X		4-15	2.5-10	0-7.5	0-5
14	MOBILE HOME PARKS	1	X		X		X		7.5-15	5-10	1-7.5	1-5
15	TRANSIENT LODGING	2	11.5-22.5 X	7.5-15	X		X		4-15	2.5-10	0-7.5	0-5
19	OTHER RES NEC	2	X		X		X		4-15	2.5-10	0-7.5	0-5
	INDUSTRIAL / MANUFACTURING											
21	FOOD & KINDRED PRODUCTS	4	0-7.5	0-5	O		O		O		O	
22	TEXTILE MILL PRODUCTS	2	0-7.5	0-5	O		O		O		O	
23	APPAREL	4	0-7.5	0-5	O		O		O		O	
24	LUMBER & WOOD PRODUCTS	3	0-7.5	0-5	O		O		O		O	
25	FURNITURE & FIXTURES	4	0-7.5	0-5	O		O		O		O	
26	PAPER & ALLIED PRODUCTS	3	0-7.5	0-5	O		O		O		O	
27	PRINTING & PUBLISHING	3	0-7.5	0-5	O		O		O		O	
28	CHEMICALS & ALLIED PRODUCTS	5	0-7.5	0-5	O		O		O		O	
29	PETROL REFINING & RELATED	5	0-7.5	0-5	O		O		O		O	
	INDUSTRIAL / MANUFACTURING											
31	RUBBER & MISC PLASTIC GOODS	3	0-7.5	0-5	O		O		O		O	
32	STONE CLAY & GLASS	3	0-7.5	0-5	O		O		O		O	
33	PRIMARY METALS	5	0-7.5	0-5	O		O		O		O	
34	FABRICATED METALS	5	0-7.5	0-5	O		O		O		O	
35	PROF SCIENTIFIC & CONTROL INSTRM	3	7.5-22.5	5-15	1-15	1-10	0-7.5	0-5	1-15	1-10	0-7.5	0-5
39	MISC MANUFACTURING	4	0-7.5	0-5	O		O		O		O	
	TRANS, COMM & UTILITIES											
41	RAILROAD RAPID RAIL TRANSIT	5	0-7.5	0-5	O		O		O		O	
42	MOTOR VEHICLE TRANSPORT	5	0-7.5	0-5	O		O		O		O	
43	AIRCRAFT TRANSPORT	5	0-7.5	0-5	O		O		O		O	
44	MARINE CRAFT TRANSPORT	5	0-7.5	0-5	O		O		O		O	
45	HIGHWAY & STREET ROW	5	O		O		O		O		O	
46	AUTO PARKING	5	0-7.5	0-5	O		O		O		O	
47	COMMUNICATION	3	7.5-22.5	5-15	1-15	1-10	0-7.5	0-5	1-15	1-10	0-7.5	0-5
48	UTILITIES	3	0-7.5	0-5	O		O		O		O	
49	OTHER TRANS COMM UTILITIES NEC	5	0-7.5	0-5	O		O		O		O	
	COMMERCIAL RETAIL TRADE											
51	WHOLESALE TRADE	5	0-7.5	0-5	O		O		O		O	
52	BUILDING MATERIAL RETAIL	5	0-7.5	0-5	O		O		O		O	
53	GENERAL MERCHANDISE RETAIL	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
54	FOOD RETAIL	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
55	AUTOMOTIVE RETAIL	4	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
56	APPAREL & ACCESSORIES RETAIL	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
57	EATING & DRINKING PLACES	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
59	OTHER RETAIL THEATERS NEC	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
	PERSONAL & BUSINESS SVCS											
61	FINANCE INSURANCE REAL ESTATE	3	7.5-19 X	5-12.5	1-15	1-7.5	0-7.5	0-5	1-11.5	1-7.5	0-7.5	0-5
62	PERSONAL SERVICES	2	7.5-19 X	5-12.5	1-15	1-7.5	0-7.5	0-5	1-15	1-7.5	0-7.5	0-5
63	BUSINESS SERVICES	2	7.5-19 X	5-12.5	1-15	1-7.5	0-7.5	0-5	1-15	1-7.5	0-7.5	0-5
64	AUTO REPAIR SERVICES	3	0-4	0-2.5	O		O		O		O	
65	PROFESSIONAL SERVICES	2	7.5-22.5 X	5-15	1-15	1-7.5	0-7.5	0-5	1-15	1-7.5	0-7.5	0-5
66	CONTRACT CONSTRUCTION SERVICES	5	0-7.5	0-5	O		O		O		O	
	INDOOR REC SERVICES	3	7.5-19	5-12.5	1-11.5	1-7.5	0-4	0-2.5	1-11.5	1-7.5	0-4	0-2.5
69	OTHER SERVICES NECESSARY	2	7.5-22.5 X	5-15	1-15	1-7.5	0-7.5	0-5	1-15	1-7.5	0-7.5	0-5
	PUBLIC & QUASI-PUBLIC SVCS											
67	GOVERNMENT SERVICES	4	X		4-15 X	2.5-10	0-5 X	0-2.5	4-15	2.5-10	0-5	0-2.5
68	EDUCATION SERVICES	1	X		X		X		X		0-7.5	0-5
711	CULTURAL ACTIVITIES	1	X		X		X		X		0-7.5	0-5
651	MEDICAL & OTHER HEALTH SERVICES	1	X		X		X		X		0-7.5	0-5
624	CEMETERIES	4	1-11.5	1-7.5	O		O		0-4	0-2.5	O	
691	NON PROFIT ORGANS (INCL CHURCHES)	2	X		X		X		X		0-7.5	0-5
	OTHER P & QP SERVICES	2	X		X		X		X		0-7.5	0-5
	OUTDOOR RECREATION											
761	PLAYGROUND & NEIGH PARKS	2	O		O		O		O		O	
762a	COMMUNITY & REG PARKS	2	O		O		O		O		O	
712	NATURE EXHIBITS	3	7.5-11.5	5-7.5	X		X		0-7.5	0-5	O	
722	SPORTS ASSEMBLY	3	7.5-11.5	5-7.5	X		X		0-7.5	0-5	O	
741a	GOLF COURSE, RIDING STABLES	4	1-11.5	1-7.5	O		O		0-4	0-2.5	O	
743-4	WATERBASED REC AREAS	4	1-11.5	1-7.5	O		O		0-4	0-2.5	O	
75	RESORTS & GROUP CAMPS	3	7.5-11.5	5-7.5	X		X		0-7.5	0-5	O	
721	ENTERTAINMENT ASSEMBLY	2	X		X		X		X		0-7.5	0-5
	OTHER OUTDOOR REC NEC	3	7.5-11.5	5-7.5	X		X		0-7.5	0-5	O	
	AGRICULTURE, MINING & OPEN											
81 EXC	FARMS, EXCEPT LIVESTOCK	3	O		O		O		O		O	
81-17	LIVESTOCK FARMS	4	O		O		O		O		O	
82	AGRICULTURE RELATED ACTIVITIES	5	O		O		O		O		O	
83	FORESTRY ACTIVITIES	5	O		O		O		O		O	
84	FISHERY ACTIVITIES	3	O		O		O		O		O	
[illegible]	MINING ACTIVITIES	5	O		O		O		O		O	
[illegible]	UNDEVELOPED LAND	5	O		O		O		O		O	
[illegible]	WATER AREA	5	O		O		O		O		O	

O-Land use and structures compatible

X-Land use and structures not compatible

Numbers-Land use compatible and structure noise reduction required to the degree indicated.

a-Standard Land Use Manual Code

b-Noise Sensitivity Code

1-Use only/no buildings
2-Open space only
3-Low intensity
4-Airport related only

Figure 3-7. Land Use Compatibility Matrix

*The foregoing are representative land uses. For uses not listed use the standards for the most compatible use.

*The numbers are noise reduction factors. See attachment for a description of their use.

*Noise reduction factors generally apply to those areas of structures where the public is received, office areas and other areas where the normal noise level is low. Excluded areas would include such activities as factory work areas.

	Lot Area	Lot Coverage	Density of Dwelling Units
CUD 1	Ten (10) Acres	Zero (o) Percent	None
CUD 2	Five (5) Acres	Twenty (20) Percent	None
CUD 3	Three (3) Acres	Twenty (20) Percent	None
CUD 4	Two and one-half (2-1/2) Acres	Twenty-five (25) Percent	None
CUD 5	One (1) Acre	Thirty (30) Percent	None
CUD 6	One (1) Acre	Thirty (30) Percent	None
CUD 7	Two and one-half (2-1/2) Acres	Twenty-five (25) Percent	One (1)
CUD 8	Two and one-half (2-1/2) Acres	Twenty-five (25) Percent	One (1)
CUD 9	One-fourth (1/4) Acre	Fifty (50) Percent	One (1)
CUD 10	One-fourth (1/4) Acre	Fifty (50) Percent	One (1)

CRITERIA FOR ALL COMPATIBLE USE DISTRICTS

Within the boundaries of the CUDs, there are certain land uses which are recognized as being incompatible. These land uses are not in the public interest and therefore must be restricted and/or prohibited.

1. Uses which release into the air any substance which would impair visibility or otherwise interfere with the operation of aircraft, such as, but not limited to, steam, dust and smoke.
2. Uses wich produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.
3. Uses which produce electrical emissions which would interfere with aircraft communication systems or navigational equipment.
4. Uses which would attract birds or waterfowl, such as but not limited to dumping of garbage, maintenance of feeding stations, or the growing of certain vegetation.
5. Uses which extend into the air within ten feet of the approach-departure surface and/or transitional surfaces.
6. Uses which exceed a height of 150 feet above the runway elevation.

Compatible Use Districts 9 and 10 are not subject to continuous overflights of less than 1000 feet AGL but do require the same noise standards as found in CUDs 7 and 8 respectively.

In most cases it will be neither practical nor realistic to simply overlay the Compatible Use Districts on a vicinity map and adopt a corresponding ordinance. These CUDs should serve as the basis for final districting decisions together with other land use determinants to form the comprehensive land use plan.

IMPLEMENTING THE PLAN

The Airport Environs Compatibility Land Use Plan can be implemented by several methods. The most practical means is zoning. Land trades and the purchase of either easements or fee are the other methods.[40] The Compatible Use District offers the vehicle for decision-making for each method. For zoning, it offers a reasonable, rational approach which is not arbitrary. For easement or fee purchase, it serves as the guide for the priority of acquisition. It also outlines what rights or restrictions must be purchased.

For zoning purposes, the strengths of the CUD system are vitally important, particularly when contrasted with other airport area land use approaches. The Compatible Use District is less vulnerable to litigation than simple noise zoning because it aggregates a number of land use determinants and covers the entire impact area.

In terms of shape, the CUD system is not arbitrary. It fits a clearly defined situation. The placement of each district line can be substantiated. The number of districts recognizes different degrees of influence and allows a full range of land uses. Reasonable land use restrictions are held to the absolute minimum, thereby allowing the individual landowner the maximum economic return while protecting the installation and area inhabitants. The land use standards have a firm, scientifically authoritative basis. They are neither too restrictive nor too permissive.

The CUD system protects and promotes the public health, safety and welfare. It is comprehensive. It is long range. It offers a means by which political decisions can be made. It is firmly rooted in a policy plan.

THE LAND USE PLAN

The Airport Environs Compatibility Land Use Plan should not be considered an end in itself. It should be considered as one of many inputs into a comprehensive environmental land use planning process. The CUD system only determines land use compatibility with aircraft operations. It does not consider the compatibility of land uses with each other, nor does it consider compatibility based on other land use determinants.

The total environmental land use planning process is designed to determine the intrinsic suitabilities of land areas. This process requires an evaluation of natural features such as soil suitability, surficial geology, hydrology and physiographic features, etc. This process is commonly called ecological land use planning. It was developed by Ian L. McHarg and is described in his book, Design With Nature.[41] This process is now being used throughout the United States.

Examples of how ecological planning factors can help in airport planning are the cases of flood plains and septic tanks. Many states have flood plain zoning acts. Where a flood plain falls within a CUD, uses such as residences may be prohibited due to the flood danger. In the case of septic tanks, it may be determined that they are not allowable because of soil and geologic factors. As a result, development may be delayed or prevented through zoning.

The results of the ecological analysis should be consolidated, mapped and overlayed on the Compatible Use Districts. A tentative comprehensive land use plan can then be formulated. This plan should be compared with, and analyzed against, existing land use, future land use plans previously prepared, and future transportation plans.

Final allocation of land uses should be the result of a detailed economic demand analysis. It is not reasonable to zone large areas for uses that will never materialize. Planned, orderly growth does not mean zoning the entire jurisdiction as residential. Few areas in the United States have the economic demand to develop entirely. Less than optimum areas such as steep slopes, flood plains, coast lines and airport vicinities should be restricted as much as necessary.

There are many other factors to consider, such as landownership patterns and land values and the cost and availability of public facilities and utilities. Planning is a compromise between competing land use elements. Intrinsic suitability modified by man-made restrictions (such as aircraft operations), are simply merged with economic and social demand factors to produce the plan for future land use.

ZONING

Zoning is a complex and detailed process. Recognition of this fact has caused a number of planners and lawyers to specialize in the zoning process. Zoning is much more than merely inserting the names of cities and counties in the blanks of a model ordinance.

Model ordinances are a valuable tool. They are needed but they must be modified to meet unique, local conditions. In almost every case, model ordinances must be altered to meet the provisions of state enabling acts, state court decisions and existing local ordinances.

State legislation for airport environs compatible land use zoning varies considerably. Within the legislative framework there are essentially two zoning options: airport zoning and comprehensive zoning. Many states have enacted the FAA Model Airport Zoning Act. Ordinances enacted under this act are primarily directed at obstructions and other dangers to flight. Such ordinances do not regulate land use in the normal sense. Most comprehensive zoning acts do not cover the items covered in the Airport Zoning Acts although most airport zoning acts do contain a provision allowing for the incorporation of airport zoning ordinances into comprehensive zoning ordinances.[42]

Because neither act covers the full range of airport environs considerations, compatible use zoning ordinance should draw from both acts. Of course, the ideal situation would be to have a single act covering the airport question.

It has been stated that use of the airport zoning ordinance is illegal because it constitutes taking without due compensation. Such a gross indictment is misleading. Although some airport zoning ordinances have had court problems, they are not all invalid per se. The main problem has been the use of unreasonable and/or arbitrary standards.

The Indiana Toll Road Commission v. Jankovich[43] is a leading case on the validity of the FAA Model Airport Zoning Ordinance. The Indiana Supreme Court held that the ordinance constituted a taking without due compensation. Although the U. S. Supreme Court refused to hear the case, "it found that the Indiana Supreme Court did not contemplate the wholesale invalidation of airport zoning ordinances, but only those parts which denied the reasonable and ordinary use of airspace by the super adjacent residents."[44]

According to the Duke Law Journal, to be valid an ordinance "must satisfy several vaguely enunciated tests" which include that: 1) "The regulation must not deprive the landowner of every beneficial use of his property" and 2) "It must confer upon the public a benefit which is on balance with the burden imposed on the private property."[45]

Based on the above test, Mutual Chemical Co. v. City of Baltimore[46] and Dutton v. Mendocino County[47] found airport ordinances invalid because it was determined that only the users of the airport benefited. Contrasted to the above decisions are Florida[48] and Alabama[49] decisions which upheld ordinances as promoting the public safety for both the users of the airport facilities and the area inhabitants.

The best summary of the constitutional consideration of "taking" is found in The Quiet Revolution In Land Use Control:

> "First, if one really studies the cases the law on this subject has by no means been as bad as most people seem to assume. The Supreme Court of the United States has frequently upheld regulatory systems that prevent any development of a man's land if the regulation is essential to promote the public health or safety, and the preservation of a livable environment and a desirable ecological balance is in the long run clearly essential to the health of the nation. 'Brandeis briefs' and expert ecological testimony, when combined with a sophisticated analysis of existing case law, can provide sound constitutional arguments for the validity of many regulatory measures that might otherwise be thought so restrictive as to require compensation.
>
> Second, draftsmen of regulations need to make a careful analysis of the types of activities that may be allowed to take place on land without destroying environmental values. Too often regulations have taken the form of blanket prohibitions when a variety of activities could be permitted on the land without detraction from the values that the regulations are designed to protect."[50]

It is apparent that what really matters is a set of reasonable, non-arbitrary land use standards which protect and promote the public health, safety and welfare. It is suggested that the Compatible Use District system meets these criteria.

Bosselman and Callies offer what may be the most beneficial advice available when they say:

> "Those who create systems of land regulation based on modern ecological knowledge should be aware of the constitutional issue, but should not be so afraid of it that they ignore the approaches that are available for working creatively within the constitutional limits."[51]

ZONING LEGISLATION

In Chapter I the new wave of legislation was briefly discussed, focusing on the proposed Land Use Policy and Planning Assistance Act of 1973 (S. 268), the Florida Environmental Land and Water Management Act of 1972 and the proposed Washington Land Use Act. Although they are an indication of the future, most immediate work must be accomplished within the existing legislative framework.

In the State of Texas, land use regulation is severely limited because there is no enabling legislation for county zoning. Texas does have an airport zoning act[52] but it does not allow general land use zoning. An amendment to this act has been introduced in the Texas Legislature. If enacted, this bill will allow implementation of the Compatible Use District System in Texas.

The State of Arizona has both county zoning[53] and airport zoning.[54] The county zoning act does not allow zoning based on noise exposure. It also specifically prohibits zoning provisions concerning construction standards.[55] The airport zoning act uses the FAA model. In order to fully implement a system such as CUD, these deficiencies should be corrected. The greatest legislative strength for immediate work will come from suing both acts. California law[56] sets noise criteria for new airports, noise land use compatibility standards and implementation procedures. The law excludes military airports and establishes its own noise system (CNEL). California also has a modification of the standard airport zoning ordinance.[57]

Other states having some type of airport zoning act, which were reviewed by the author, are New Mexico, Arkansas and Mississippi. In each case, revisions are warranted to allow full enabling powers.

An Act deserving special note is the Minnesota Airport Zoning Act.[58] Although it is designed for a special purpose, a new airport in Minneapolis-St. Paul area, it has some interesting provisions. It stipulates that when the site is selected all non-zoned land in the vicinity is automatically zoned agricultural.[59] Even more important is the provision concerning noise:

> "...The metropolitan council shall determine the probable levels of noise which will result in various parts of the metropolitan area from the operation of aircraft using the site, shall establish aircraft noise zones based thereon applicable to property affected by such noise, and shall establish acceptable levels of perceived noise decibels for each land use, using the composite noise rating method and tables or the noise exposure forecast method and tables. Each government unit having power to adopt land use and development control measures applicable to property included in any aircraft noise zone, shall adopt or incorporate in existing land use and control measures the applicable acceptable level of perceive noise

> decibels established by the council, and shall adopt such other control measures as may be necessary to prevent the use, construction or improvement of property and buildings under its jurisdiction so that persons using the property and buildings are subjected to a level of perceived noise decibels in excess of the acceptable level established for that land use..."[60]

There is a wide range of legislative approaches to airport environs compatible land use control. The spectrum runs from virtually no control, to specific statewide systems, to single area legislation. There appears to be a legislative precedent for virtually every concern. There are several problems, though. Every state is different. Based on the author's evaluation, there is no optimum legislation. The net result is a different, piece-meal approach in each state. In the interest of the general health, safety and welfare a national system should be considered. At the very least an optimum system should be developed and a concerted effort should be made for adoption by every state.

IMPLEMENTATION STRATEGY

The Compatible Use District System is worthless without effective implementation. Viewed from the perspective of the airport operator, implementation is a complex combination of professional planning input, public relations and plain politics. Assuming he has completed the Airport Environs Land Use Compatibility Plan, he can then approach local authorities.

The first step may be to initiate low key, behind the scenes, discussions with key policy makers, local interest groups and the professional planning staff. On the other hand he may decide to go to the public initially. This decision must be based on an evaluation of the local situation.

In either case a wide range of participants must be incorporated into the process and "sold" on the concept. If there is a local planning staff it must be brought into the program early. The planning commission and local legislative body will approve or reject the plan. Local interest groups which rely on the airport can be mobilized. Perhaps the most important actor is the landowner. If he can be "won over," even partially, it makes the process much easier. Federal, state and regional authorities can also be called upon to assist locally or perhaps legislatively at the state and federal levels.

Following a thorough inventory and appraisal of friends and foes, the Compatible Use District Plan can be adapted to the local conditions. Much of the adaptation can be accomplished with or by the local planning or zoning staff. In some communities, there are no professional planners. There may be a city or county attorney and a lay planning commission with little knowledge of the legal or practical aspects of the zoning process. Under no circumstances should the airport operator allow such a group to enact an ordinance that does not meet the provisions of the state enabling act or which otherwise might be declared illegal or unconstitutional. It takes only one developer, his consultants and attorneys to defeat such an ordinance.

Assuming that the plan and ordinance have been properly adapted, the next step is to present and sell it to the local policy makers. In some communities there will be little difficulty. The affected land may be grazing land some distance from the nearest development.

In other cases the opposition will be fierce. The word will go out that the airport operator is going to render all the adjacent land useless. Every landowner who has been holding his land for speculative profit will come to the hearing with his consultants and attorneys. The airport operator is at a disadvantage and is believed insensitive to the welfare of the little man, the landowner. Many of landowners are friends of the local policy makers. In some areas of the country, any type of land use control is almost considered un-American.

How can these obstacles be overcome?

The first prerequisite is thorough preparation. The airport operator should know exactly what he needs in that situation and what is possible before ever going public. The materials and procedures presented in this report should be assembled. A thorough knowledge of the local political climate should be developed along with information concerning who owns the land and what they intend to do with it.

Simply stated he must first know his opposition and his plan of attack. Secondly, he must have the proper weapons to win.

With all of the preparation completed the proposal should be discussed with the planning staff or if there is no staff, a friendly policy maker. If there is a comprehensive plan, the land use policies previously discussed should be submitted as a possible amendment. A generalized land use plan could also be presented. The initial approach should avoid the specifics and the details. The possibility of rejection is much greater with details than with policies and general land use plans.

The most important point to convey to the public, landowners and policy makers is that the land will not be rendered economically worthless. A feature news story in the local newspaper outlining this fact along with the policies would be advisable.

There are numerous facts to use in support of the Compatible Use District concept. If the community is dependent on the airport, examples of previous airport closures would be helpful. The economic base aspect is vital. How much money does the airport pump into the local economy annually? In some states there are state agencies that can assist in this presentation. In Texas, the Texas Industrial Commission has a legislative mandate to encourage and protect major industries. Airports are major industries.

Details of major accidents such as the recent crash in Sacramento, California, should be used. Reference should also be made to S. 268 and S. 924 now pending before the Congress.

Following the policy presentation and adoption, the ordinance should be presented. It should be explained in detail. Care should be taken to clearly convey the extent of regulations. Each provision should be supported by factual data. The presentation should stress the validity of the regulation by presenting back-up data and citing the sources of the regulation. The presenter should stress the importance of the regulation while conveying to the policy makers and landowners that every attempt was made to keep regulation to the absolute minimum needed to protect the public and the continued operation of the installation.

Above all else the presenter must know his subject well. He must be able to present intelligently and be able to rebut skillfully the attacks of the opposition. If not, the case for the Compatible Use Districts could be lost in the public hearing.

The defense of the ordinance will be minimal if all of the above has been accomplished. Where an ordinance is under attack at the local policy level or in the courts, qualified planners and land use attorneys should be employed. In some communities there is little or no enforcement of zoning ordinances. Because of this, airport operators must continuously monitor development activity. If violations take place they should be brought to the attention of local authorities. If nothing is done, the airport operator should file suit for compliance.

The Compatible Use District implementation is never complete. Continual monitoring and defense is required. Even with a good ordinance or easements, the program is only as good as its enforcement. It will only take one crucial mistake to defeat the whole effort.

SUPPLEMENTARY METHODS OF ZONING

In recent years several zoning innovations have been developed. Planners have long recognized that zoning can become a straight-jacket when oversimplified. The result of such simplification is often a rather poor solution to the land use question. Because traditional zoning is essentially unresponsive to modern problems, planners have developed supplementary zoning tools.

One of the most successful of these innovations is the planned unit development (PUD) concept. In its basic form, a planned unit development supersedes the underlying zoning for a given area. A plan is submitted and the development scheme is then negotiated to completion between the developer and the city or county. These negotiations are governed by pre-identified standards, policies and criteria found in the zoning ordinance.

There are several significant advantages of the planned unit development. The concept allows for deviation from specification standards such as setbacks, individual lots and other similar zoning provisions. The PUD approach is also a means by which several land uses (usually separated by conventional zoning) can be mixed in a totally planned design. The options are many. With adequate guidelines and a good review process, superior development will result.

The PUD concept can be extremely useful in airport environs planning and zoning. As was mentioned previously, the Compatible Use District criteria, based solely on aircraft considerations, sets parameters of development. These parameters allow different uses in the same area. Through the PUD process, good development can be accomplished mixing these uses. Conventional zoning does not allow such flexibility. The result is the possibility of greater economic return for the developer while fulfilling the Compatible Use District requirements. This is an excellent way to prevent challenges based on the "taking without due compensation" argument.

The PUD approach is also good where a single ownership falls within two or more CUDs. Under conventional zoning, part of the property may be restricted to no residential use while the other may be limited to low density uses. The owner may say that part of the land has been "taken." Using the PUD approach, it is possible to allow higher density on the less regulated part of the property while keeping the rest in open space. The number of units on the developed part could equal the number possible on the whole tract under conventional residential zoning. An ordinance approving the PUD would keep the open space in that use.

Experience with planned unit developments indicates that superior development has been achieved; often with higher developer profits. The PUD approach can increase the number of development options while decreasing the possible legal problems.

The conditional use (CU) concept is somewhat similar to the planned development. The major difference is scale. Conditional use provisions usually cover smaller areas and single uses.

Under this concept a given use is allowed in a given area assuming certain preidentified conditions are met. The city or county evaluates each case. Noise Reduction Factors can be implemented by this approach, as well as through the planned development procedure.

Use of both the planned unit development and conditional use concepts under certain circumstances is an extremely useful aid to the effective implementation of the Compatible Use District system. These procedures allow for the flexibility required to adopt and effectuate ordinances. In most cases, the development options will be much more reasonable and thus less vulnerable to legal contest.

There are three other zoning concepts which deserve mention, although they are less clearly defined and are subject to some legal questions. The first is contract zoning. It is similar to the PUD and CU procedures. Without detailed guidelines the possibility of a "spot" zoning charge is likely, however.

Closely related is the procedure of requiring the dedication of easements as a condition for approval. This process has long been used in the subdivision approval process for streets and utilities easements. In large scale development it has been used to obtain school sites. Subject to further research, easement dedication through PUD, CU, and contract zoning should be considered for Compatible Use District application.

A final zoning concept concerns the trade or combination of development rights. In cases where a piece of land is severely restricted, it is possible to combine development rights with another property and share the profits. Implementation of this concept through zoning is still the subject of legal discussion but it does offer some possibilities. Where the community feels strongly about retention of an airport, this may be an excellent type of voluntary program.

In some states, there is legislation which encourages the preservation of open space through land registration and tax relief. The owner puts his land under the program for a given number of years and his tax rate is reduced appropriately. Where land is taxed at fair market value and speculation has increased values, this program is particularly helpful. In states having these programs, such as Maine and Washington, efforts should be made to include the Compatible Use District system. Another possibility for tax relief is local tax action.

The supplementary methods discussed above offer excellent possibilities for better permanent solutions. There are others such as the many federal grant programs. Every effort should be made to utilize these methods and procedures although additional research is required.

ZONING ALTERNATIVES

Zoning is obviously the most practical and the least expensive method of implementing the Compatible Use District concept. Unfortunately, zoning can be changed by a shift in local politics. In addition, there is always the possibility that an ordinance may be successfully challenged in the courts. There are other methods. At airports where any incompatible land use encroachment is totally unacceptable, other means should be considered.

Airport operators and planners are well aware of these zoning limitations and, as a result, have identified other options. The most permanent method is fee purchase of the impact area. This is the approach used for major international airports being built today. The problem is that between 18,000 and 20,000 acres must be purchased. Even in undeveloped areas, the cost is considerable. Acquisition of such areas near existing airports would be prohibitive.

Because of funding difficulties and political considerations very little hope can be encouraged for major utilization of this approach. The costs for most airports would be considerable. Of course, this note of pessimism assumes that the airport would buy the land and either hold it or use it for airport use.

Outside the military the fee purchase approach is undergoing some rethinking. Namely, how can one make the situation economically feasible? The answer to buy and lease or to buy, develop (with compatible use) and sell. A modification would be to buy and sell with deed restrictions or covenants or to buy and sell while retaining easements.

There is little doubt that any of the above would accomplish the desired goals. It is also likely that a net profit could result. There is precedent for such thoughts, even for government agencies. The HUD urban renewal program operates on a similar principle. A blighted area is purchased or condemned and then redeveloped by a local agency or private developer according to certain standards. The potential exists. Further research and evaluation needs to be undertaken.

Most airports seem to have limited amounts of fee owned land at the ends of the runways In some cases, there are other low use fee parcels located in less critical Compatible Use Districts within the airport proper which could be sold or traded with deed restrictions or covenants. In such cases, it is only logical to act according to the CUD priorities and negotiate trades where feasible.

Of all the zoning alternatives, easement acquisition is the most realistic, immediate option. There are many types of easements. For Compatible Use District application there are essentially three: (1) clearance (2) avigation and (3) restrictive use.

Clearance easements have been used in approach and clear zones. Near the runway, they tend to restrict land use but just a short distance farther away, they have little effect on the actual use of the land.

The avigation easement has been discussed favorably by civilian planners.[61] These easements grant the right to fly over the property and have the effect of precluding suits based on trespass, damage and nuisance. Although the federal government has retained control of navigable airspace, there are situations where "low and frequent flights" may constitute "taking" or serve as the basis for monetary judgments for trespass, damage and nuisance. One might suggest that the purchase of avigation easements is, in effect, admitting that navigable airspace belongs to the land. This is not necessarily the case. Airspace ownership appears to be a factor of the height and frequency of the flights. At low altitudes, avigation easements appear to be appropriate while at higher altitudes they would be unnecessary.

The restrictive use easement offers the most comprehensive coverage. These easements actually become private zoning. Strictly speaking, restrictive use easements are not really easements. In the pure sense, they are legal instruments for the transfer of a portion of the "bundle of rights," namely, certain development rights.

The concept of real estate ownership is known as the "bundle of rights." Ownership is normally thought of as fee ownership which includes many other rights. Fee title is the most marketable. If a portion of these rights are eliminated, the options are reduced as well as the value.

The above is extremely important for Compatible Use District application. Each restriction constitutes the purchase of part of the bundle of rights. In a practical sense the development rights package is already restricted. Land use zoning may have eliminated all but one type of development right. If that right is purchased in the form of a restriction, the purchaser has really bought the whole package and might as well obtain fee ownership. Natural factors such as soil suitability may do the same thing. If there is no economic demand for the rights not purchased, a similar situation results.

In view of the above, it is absolutely imperative to purchase only those rights which are the minimum required to assure compatible land use. Only through detailed analysis can this be achieved.

It was stated earlier that the ten CUDs can serve as the basis for easement acquisition. From the airport operators point of view, these districts (or modifications) identify the minimum requirements.

Easements would class land uses in three categories: (1) acceptable, (2) not acceptable and (3) acceptable with conditions. If for the sake of simplicity uses acceptable with conditions are called unacceptable the cost of easement may increase. Due to local factors, that land use may have been the only use which was economically feasible. If it is eliminated by easement, the purchaser must pay the price of fee ownership while obtaining only an easement.

Easement proposals would cover all CUDs. It is not necessary to obtain all of them. They are listed in priority sequence for that purpose.

FINDINGS

1. Military airports, like civil airports, represent a national resource which must be protected.
2. Military and civil airports are being subjected to incompatible urban development which is threatening the operational capability and the public interest which they serve.
3. Incompatible land development near military and civil airports result in exposing people to excessive noise.
4. Any attempt to solve the airport land use (environmental) problem must consider noise exposure, accident exposure and hazards to flight from adjacent land uses. Solution of the noise problem alone is an inadequate piecemeal approach.
5. Control of land use development in the airport environs is generally perferable to the acquisition of property rights which may remove land from the local tax rolls.
6. The control of incompatible land use adjacent to airports clearly falls within the police power to zone land for the protection and promotion of the public health, safety and welfare.
7. In order to properly control land use in the airport environs to the benefit of all there must be an interchange of information between the community and the airport operator.
8. Although most states have enacted airport zoning acts most of this legislation is directed at the control of hazards to flight instead of the protection of

people. Without legislation which specifically recognizes the requirement for airport environs compatible land use, realistic solutions cannot be achieved.

9. The response by local governments to regulate land use in the airport environs has generally been inadequate.

10. Federal legislation covering airport environs land use, similar to the proposed National Land Use Policy and Planning Assistance Act of 1973, is required.

RECOMMENDATIONS

1. The Congress should establish a policy that the effort to solve the problem of airport land use compatibility be primarily directed toward land use planning and regulation. Said policy should recognize the utility of limited acquisition where hazard and corresponding land use restriction would constitute "taking without due compensation" and the use of economical sound suppression.

2. The Congress should adopt the following statement of policy:

   a. In order to promote and protect the public health, safety, peace, comfort, convenience and general welfare of the citizens of the United States it is hereby declared that it is necessary to:

      i. Guide, control and regulate future growth and development in the vicinity of airports.

      ii. Promote orderly and appropriate use of land in the vicinity of airports.

      iii. Protect the character and stability of existing uses in the vicinity of airports.

iv. Prevent the destruction or impairment of the airport and the public investment therein.

v. Enhance the quality of life in the vicinity of airports,

vi. and protect the general economic welfare by restricting incompatible land use in the vicinity of airports.

b. In order to effectuate the purpose of the above it is hereby declared that it is necessary to:

i. Develop airport environs land use compatibility plans for all airports.

ii. Implement appropriate legislation and ordinances to implement said plans.

iii. Restrict or prohibit incompatible land use.

iv. Establish standards of land use compatibility.

v. Prevent the establishment of any land use which would endanger citizens of the United States or the continued use of an airport.

c. Within the airport environs, there are certain land uses which are declared to be incompatible. These land uses are hereby declared not in the public interest and therefore shall be restricted and/or prohibited:

i. Uses which release into the air any substance which would impair visibility or otherwise interfere with operation of aircraft, such as but not limited to steam, dust and smoke.

ii. Uses which produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision.

iii. Uses which produce electrical emissions which would interfere with aircraft communications systems or navigational equipment.

   iv. Uses which would attract birds or waterfowl, such as but not limited to dumping of garbage, maintenance of feeding stations or the growing of certain vegetation.

   v. Uses which violate the height restrictions established by the Federal Aviation Administration for the airport environs.

d. It is recognized that certain noise levels of varying duration, intensity and frequency affect both physical and mental health. It is further recognized that a definite danger to life exists in certain areas adjacent to airports. Where such conditions exist it is hereby declared inconsistent with the public health safety and welfare to allow incompatible land use.

e. It is recognized that certain land areas below flight paths in the vicinity of airports are exposed to significant danger of aircraft accidents. Therefore it is necessary to limit the density of development and intensity of use.

f. It is recognized that different land uses have varying sensitivities to noise. Therefore, standards of acceptability based on noise sensitivity are necessary and a system of noise reduction standards for construction is required.

g. It is hereby declared that land use planning and regulation in the airport environs cannot rest solely on aircraft considerations. Therefore, the allocation of land uses within the airport environs must be further refined by analysis of, but not limited to:

   i. Physiographic features

   ii. Climate and hydrology

   iii. Vegetation

   iv. Surface geology

   v. Soils characteristics

vi. Intrinsic land use suitability

vii. Economic and social demand

viii. Land ownership patterns and value.

xi. Existing land use.

x. Cost and availability of public utilities

xi. Cost and availability of transportation

xii. Cost and availability of community facilities.

3. The Congress should enact legislation which would require the states and their political subdivisions to control the use of land in the vicinity airports. Such legislation would require compatible land use regulation based on noise exposure, accident exposure to adjacent land uses and hazards to flight from adjacent land uses. This legislation should include recommended procedures for settling claims resulting from the compatible land use regulation together with annual authorizations and appropriations to settle such claims.

4. The Congress should establish the mechanism to:

   a. Develop a methology for airport environs land use compatibility planning based on detailed analysis of, but not limited to:

      i. Flight patterns

      ii. Flight profiles

      iii. Types of aircraft

      iv. Magnitude, nature and time of flight operations

      v. Accident hazard (occurance, location, impact area)

      vi. Aircraft flight characteristics

      vii. Noise exposure using noise exposure forecast or a suitable modification thereof.

viii. Standards of land use compatibility related to hearing damage, adverse physiological reactions, psychological disorders and accident impact hazard.

Said planning methodology would designate areas in terms of compatibility with aircraft operations including prohibition, acceptability with density, intensity of use and noise attenuation or reduction standards and acceptability with no restrictions. Standards for modification or adaptation to local conditions would also be included.

b. Assist state and local governments to develop airport environs land use compatibility plans, legislation and ordinances.

REFERENCES

1. DOD Draft Environmental Impact Statement on Air Installation Compatible Use Zone, Department of Defense, Washington D. C., March 19, 1973.

2. P. A. Shahady, "Department of Defense Noise Research Programs - Source Noise Abatement Technology," Department of Defense, Air Force Aero Propulsion Laboratory, 21 March 1973.

3. P. A. Shahady, "U. S. Air Force Noise Research," presented to EPA Aircraft/Airport Noise Study Task Group 4, 16 May 1973.

4. W. S. Blazowski et al, "The Aircraft Engine and the Environment," Air Force Aero Propulsion Laboratory, 16 May 1973.

5. R. P. Burns, "Noise Pollution Control in the U. S. Navy," Naval Air Propulsion Test Center, 16 May 1973.

6. F. H. Schmitz, "Rotary Wing Acoustic Research," Ames Directorate, U. S. Army Air Mobility R & D Laboratory, 16 May 1973.

7. The Sacramento Union, September 25-26, 1972

8. The San Antonio Light, December 9, 1972

9. The San Antonio Light, December, 1972

10. The San Antonio Express, December 16, 1972

11. The San Antonio Light, February 27, 1973

12. Arizona, Chapter 15, Senate Bill No. 16, pp 519-527

Arkansas, Chapter 3, 74-301 to 74-319.

Minnesota Chapter 1111, 1969 Session Laws

Mississippi Title 28, 7544-01 to 7545-39

New Mexico, Municipal Code, Article 40, 14-40-1 to 14-40-25

California, _California Laws Relating to Aeronautics,_ Article 6.5 and _Business Regulations_, 5012 to 5022.

Texas - Vernon's Annotated Texas Statutes, Article 46e

13. See _Effects of Noise on People._ U. S. Environmental Protection Agency, Washington, D. C. 20460, December 31, 1971 (NTID300.7).

14. _Land Use Planning with Respect to Aircraft Noise,_ AFM 86-5, Department of the Air Force, 1 October 1964, p 12.

15. _Los Angeles Times,_ 11 January 1973

16. A number of military air bases have closed due to encroachment: Mitchell Field, Oxnard AFB etc. Others have ceased flying: Chanute AFB, Lowry AFB, Bolling AFB, etc.

17. Military air fields sometimes employ from 500 to 3,000 employees and may put more than $100 million annually into the local economy.

18. Laughlin AFB was closed in the late 1940's. Because it was the single largest employer the impact on the local area was severe.

19. Dollar investments for military air bases can exceed $200 million.

20. Land Use Policy and Planning Assistance Act of 1973 (S. 268), 93D Congress, 1st Session, p 25

21 A Model Land Use Development Code, Tentative Drafts 1-4, The American Law Institute, 4025 Chestnut Street, Phila, Pa. 19104

22. Florida Environmental Land and Water Management Act of 1972, p 1

23. Washington Land Use Act H. B. 791, Washington State Legislation, 1973

24. Washington Land Use Act, p 17

25. Washington Land Use Act, p 17

26. Washington Land Use Act, p 55

27. Planning Cities, Frederick H. Bair, Jr., American Society of Planning Officials, Chicago, 1970 p 356

28. The County Planning and Zoning Act of 1949 (Arizona) (Chapter 58, H. B. No. 35), Section 7

29. Section 19-903, Article 9, "City Planning, Zoning", Nebraska Statutes

30. Land Use Planning with Respect to Aircraft Noise, p 2

31. Review of Aircraft Noise Land Use Planning Procedures, William J. Galloway, Bolt Beranek and Newman, Inc. for Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, March 1972, pp 2-3

32. Review of Aircraft Noise Land Use Planning Procedures, p 8

33. California Laws Relating to Aeronautics, Article 6.5, p 396

34. Review of Aircraft Noise Land Use Planning Procedures, p 6

35. Departmental Circular 1390.2, Noise Abatement and Control: Departmental Policy, Implementation Responsibilities, and Standards, U. S. Department of Housing and Urban Development, 8/4/71

36. Review of Aircraft Noise Land Use Planning Procedures, p 14

37. HUD Circular 1390.2, 4 Aug 1971, p 8

38. Aircraft Noise Impact Planning Guidelines for Local Agencies, Beland, et al, for U. S. Department of Housing and Urban Development, Nov 1972

39. a. Noise Exposure Forecasts: Evolution, Evaluation, Extensions and Land Use Interpretations by William J. Galloway et al, Bolt Beranak and Newman, Aug 1970.

    b. Planning the Airport Environment by Michael J. Meshenberg, ASPO, 1968

    c. Cape Kennedy Regional Airport, Melbourne, Florida, Metropolitan Aircraft Noise Abatement Policy Study, Prepared for U. S. Dept of Housing and Urban Development by East Florida Regional Planning Council, 1971

    d. Review of Aircraft Noise Land Use Planning Procedures by William J. Galloway, Bolt Beranek and Newman, March 1972

    e. Outdoor Noise and the Metropolitan Environment: Case Study of Los Angeles with Special Reference to Aircraft by Melville C. Branch, City of Los Angeles, 1970

    f. Jamaica Bay and Kennedy Airport: A Multidisciplinary Environmental Study, Volumes 1 and 2, National Academy of Sciences, Jan 1971

- g. Compatible Land Use Planning On and Around Airports, Transportation Consultants, Inc., Jan 1966
- h. Miami International Airport Compatibility Study, Dade County and City of Miami Planning Departments, Dec 1971
- i. Noise Assessment Guidelines by Theodore J. Schultz and Nancy M. McMahn, U. S. Dept of Housing and Urban Development, Aug 1971
- j. An Airport Environs Plan, The Syracuse, Onondaga County Experience by William O. Thomas, AIP Planners Notebook, Oct 1971
- k. "Multidisciplinary Environmental Analysis: Jamaica Bay and Kennedy Airport" by Don C. McGrath, Jr., AIP Journal, Jul 1971

40. Air Installation Compatible Use Zone: (AICUZ) Protection of Air Force Bases Against Urban Encroachment (AF Regulation 87-14 - Draft) Department of the Air Force, Wash DC, June 29, 1972, p 1

41. Design with Nature, Ian L. McHarg, Natural History Press, Garden City, New York, 1969

42. Vernon's Annotated Texas Statutes, Article 46e, Section 4

43. 379 U. S. 897, 855 Ct 493, 13L Ed 2d 439 (1965) cited by Cheryl J. Kane, The Legal Implications of Airport Land Assembly, unpublished paper, Feb 22, 1971, p 9

44. The Legal Implications of Airport Land Assembly, Cheryl J. Kane, unpublished paper Feb 22, 1971, p 9

45. Duke Law Journal, 1965: 795-6 cited by Kane, p 8

46. U. S. Av 11 (Md Cir Ct 1939) cited by Kane, p 8

47. U. S. Av 1 (Col Supreme Ct 1948) cited by Kane, p 8

48. Harrell's Candy Kitchen, Inc. v. Sarasota - Manatee Airport Authority, 111 So. 2d 439 (Fla 1959), cited by Kane, p 9

49. Baggent v. City of Montgomery, cited by Kane, p 9

50. The Quiet Revolution in Land Use Control, Fred Bosselman and David Callies for the Council on Environmental Quality, U. S. GPO, Wash DC December 15, 1971 p 324

51. The Quiet Revolution in Land Use Control, p 324

52. Vernon's Annotated Texas Statutes, Article 46e

53. The County Planning and Zoning Act of 1949 (Arizona)

54. Arizona, Chapter 15, Senate Bill No. 16

55. The County Planning and Zoning Act of 1949 (Arizona), Sec 7

56. (California) Business Regulations, 5012 to 5022.

57. California Laws Relating to Aeronautics, Article 6.5

58. Chapter 1111, 1969 Session Laws, Minnesota

59. Chapter 1111, 1969 Session Laws, Minnesota, Section 1, Subdivision 1

60. Chapter 1111, 1969 Session Laws, Minnesota, Section 2

61. Planning The Airport Environment, Michael J. Meshenberg, American Society of Planning Officials, Chicago, 1968, p 27

Appendix A

TASK GROUP 6 MEMBERSHIP

TASK GROUP 6 MEMBERSHIP

Dr. Sidney J. Nethery (Chairman)	AIR FORCE
Mr. Lloyd Hinton	N. O. I. S. E.
Dr. Marjorie W. Evans	Sierra Club
1/Lt Terry W. Elkins	Environmental Protection Agency
Cpt. John C. Mitchell	U. S. NAVY
Mr. Ronald L. McConnell	State of Washington
Mr. James F. Miller	Dept. of Housing & Urban Development
Mr. Charles J. McCall	Airport Operators Council International
Mr. Neal Guse	Dept. of the Interior
L/C Perry A. Hudel	U. S. AIR FORCE
Mr. Wilmer Garrett	City of Fresno, Ca.
Mr. Roger G. Flynn	Air Transport Association
Mr. Thomas R. Dashiell	Dept. of Defense
Mr. Frank Carlson	Dept. of Interior
Capt. R. E. Anderson	U. S. NAVY
Mr. Ralph Auldrich	U. S. ARMY
Ms. Raelyn Janssen	Environmental Defense Fund
Mr. Brian Tennant	The Boeing Co.
Mr. Leonard J. Obery	National Aeronautics & Space Administration
1/Lt Gary D. Vest	U. S. AIR FORCE

Appendix B

RESPONSES FROM TASK GROUP MEMBERS

NATIONAL ORGANIZATION TO INSURE A
SOUND-CONTROLLED ENVIRONMENT

7 April 1973

To: Dr. Sidney Nethery, Chairman Task Group 6

From: Lloyd Hinton/John Tyler

Problem: Need to Safeguard Federal Investment in Military Air Bases.

It is suggested that the problem incurred by residential development impaction on military air bases is more serious than is generally acknowledged. According to the provision of the Noise Control Act of 1972, EPA must establish cirteria based on public health and welfare (PHW) for community exposure to aircraft noise.

The military cannot look foreward to the introduction of new aircraft having substantially lower noise levels. In fact, the revise is true. Traditionally, civil airport operators have considered noise reduction at the source to be the primary means of resolving the problem. The military cannot expect noise reduction at the source other than through operating proceedures. Therefore, the resolution of the military air base noise problem must occur~~e~~ through land use development controls or redevelopment.

Following establishment of EPA noise standards for airports, residents in areas exposed to military air base noise levels will be entitled to the same protection as those living near civil airports.

In view of the uniqueness and the magnitude of the military air base noise problem, the following recommendation are submitted:

1. DOD conduct survey to determine magnitude in terms of land area and number of people exposed to excessive noise due to air base operations.
2. DOD prepare and seek adoption of Federal legislation designed to encourage/require

state implementation of national comprehensive land use planning having aircraft/airport noise as criteria.

3. DOD undertake on urgent basis, objective analysis of aircraft/airport operating ~~pr~~ procedures to determine availability of changes to reduce noise without compromise of flight safety or mission accomplishment.

4. DOD convene major task force effort similar to EPA program to implement P.L. 92-574, to develope necessary inter-governmental and Federal inter-agency recognition and support for land use controls and changes.

It is submitted that in the absence of comprehensive controls on urban development in vicinity of military air bases, it is not possible to allocate the level of funding needed to purchase or otherwise control development in noise impacted areas.

DANAHER, GUNN & KLYNN
LAWYERS
STANFORD FINANCIAL SQUARE
2600 EL CAMINO REAL
PALO ALTO, CALIFORNIA 94306

JAMES T. DANAHER
JOHN B. GUNN
MICHAEL KLYNN
CHARLES A. KNELL
MARJORIE W. EVANS

TELEPHONE
(415) 326-1141

March 13, 1973

U. S. Environmental Protection Agency
Office of Noise Abatement
Washington, D. C. 20460

Dear Sirs:

Please find enclosed material which I am offering for the consideration of the Task Force on Military Aircraft/Airport Noise, Aircraft/Airport Noise Study Group. I would like to have that Task Force consider this material and would appreciate your forwarding it to the chairman of that task force.

Very truly yours,

Marjie W Evans

MARJORIE W. EVANS
Member U.S.E.P.A.
Aircraft/Airport Noise Study Group

ENVIRONMENTAL AND SAFETY ASPECTS OF P-3 ORION FLIGHT TRAINING PROGRAM AT U.S. NAVAL AIR STATION, MOFFETT FIELD, CALIFORNIA

March 7, 1973

Marjorie W. Evans

I. BACKGROUND

II. GEOGRAPHY

III. NOISE IMPACT

IV. SAFETY

V. AIR POLLUTION

VI. SUMMARY

Attachments:

1. Letter from U. S. Navy stating number of P-3 training flight operations at Moffett Field.
2. Map of area over which training flights occur.
3. Letter from U.S. Navy giving noise data.
4. (a, b) Tables giving noise measurements.
5. Graph displaying noise impact on neighboring areas.
6. (a, b, c) Declarations from affected citizens relative to adverse impact of Navy training operations.
7. News article relating training of Spanish aviators at Moffett Field.

March 7, 1973

ENVIRONMENTAL AND SAFETY ASPECTS OF P-3 ORION FLIGHT TRAINING PROGRAM AT U.S. NAVAL AIR STATION, MOFFETT FIELD, CALIFORNIA

(a) Submitted for inclusion as part of the study being prepared for the U.S. Navy on the impact of flying operations on neighboring communities near Moffett Field.

(b) Submitted to Federal Environmental Protection Agency, Aircraft/Airport Noise Study, Task Force on Military Aircraft/Airports.

I. BACKGROUND

The U.S. Naval Air Station at Moffett Field, Sunnyvale, California was a jet aircraft base in the 1950's. There was public concern at that time over the danger to the public generated by jet aircraft traffic, (a warranted concern, since in 1960-61 there were five nearby Moffett-related crashes and one civilian ground casualty in Mountain View) and the noise impact of the operations on the neighboring residential communities. Because of these two concerns the Navy removed the major portion of the jet activity from Moffett Field upon the construction of Lemoore Airfield in September, 1961. The base became the Pacific headquarters of anti-submarine patrol squadrons, which utilize P-3 Orion four-engine turbo-props. From 1961 to 1968 there was little hazardous or polluting flying activity by the Navy over the neighboring residential communities, and opposition to the presence of the Navy in the community was nearly if not totally nonexistent.

However, in 1968 the base was established as the location for crew training in the P-3 aircraft, and this massive training program brought back the old noise and safety problems in much more virulent form. A major portion of this program (from the point of view of the community) involves the flying of these aircraft on an elliptical path, with axes of approximately four and eight miles, around the field at an altitude of zero to 1,500 feet making touch-and-go landings on the airstrip (as well as the associated aircraft warm-up operations). In general the same plane and crew circles many times, making a landing and take off in each pass around the field. There are frequently two to three planes in a pattern, and a fly-over every one and one-half minutes is common at many residences. In this way, between 114,000 and 121,000 take-off and landings, i.e., between 57,000 and 60,500 patterns, are flown per year (see Attachment 1). Thus, the noise and danger problem removed from the community in 1961 was reimposed in 1968 in the form of a 7-day a week, 18-hours a day (from 6 a.m. to midnight) noise, air pollution, and safety problem.

II. GEOGRAPHY

The path followed by the planes in their circling training flights is shown on the map given as Attachment 2, where the solid lines delineate what appear to this writer to be the region of concentration of the flights. Planes have been observed flying the pattern outside the indicated path, e.g., at a place marked by a cross. Much of the flight pattern is over residential areas in the Cities of Los Altos, Mountain View, Palo Alto, and Sunnyvale. These residential areas were largely so zoned and were well established residential areas in the 1940's and 1950's, with some plots being so zoned as late as the middle 1960's.

There are thirty-five schools lying under the path of concentrated flying use, and many more in the larger area over which planes have been observed. These schools are marked by circles on Attachment 2.

The area of the noise impact extends far beyond the flight pattern, to a radius of five miles or more. Data is given on the next section. While a part of this area is water, (San Francisco Bay) the number of citizens in the noise-impacted area is 200,000 or more.

III. NOISE IMPACT

Noise measurements were made by the author at distances of one mile and five miles from the field. Measurements of the noise generated by the P-3's at 100 feet have been supplied by the Navy (see Attachment 3). The instrument used by the author was a General Radio Company 1565-A Sound-Level Meter. The instrument was calibrated at frequent intervals. It has a range of 38 to 140 dB and has the capability of measuring on A-, B-, and C-weighted scales.

While it is common practice to measure noise levels on the A scale on the assumption that low frequencies are less annoying than high frequencies, in the author's opinion this scale used alone is not appropriate in the case of the P-3's. The reason is that these turbo-props have a heavy component of low frequency sound waves which carry very large distances and which are extremely annoying to many people. Use of the A-scale filters out the low frequency component to a considerable extent, and understates the noise impact from these aircraft. For these reasons the author's measurements include both A- and C-weighted measurements. Data are shown in table form (Attachments 4(a) and 4(b)) and in graph form (Attachment 5). Attachment 4(a) gives data for noise levels versus distance for the aircraft. Attachment 4(b) gives noise levels measured in selected residential areas.

The graph (Attachment 5) is a semi-log plot of the noise level versus distance for these aircraft. Superimposed upon the straight lines which are drawn as an approximation between the data points are the background levels measured in the absence of the P-3 noise, with both A scale and C scale values being shown. The P-3's are seen to impose an average 8 dBA and 18 dBC noise burden on the community at a distance of two miles from the field, and a 4 to 22 dBC burden even at five miles. The variation is probably due to aircraft variation and to meteorology.

It is pertinent to examine the standrads of the communities to determine if this noise burden, which ranges up to 30 decibels at various parts of the residential area, should be viewed as a substantial environmental insult.

Northern California communities in general set as a standard 50 dBA as the maximum tolerable outdoor noise for residential areas. A Report to the 1971 Legislature on the Subject of Noise, prepared by the Advisory Committee on Noise authorized by the California State Assembly under Concurrent Resolution 165, 1970 states that California residents living in suburban residential areas want a noise level no greater than 40 dBA by day and 30 dBA by night (at page 33). It goes on to state that residents of suburban residential communities will accept without undue complaint 40 to 50 dBA during the day and 30 to 40 dBA during the night (at page 34).

The U.S. Environmental Protection Agency in its Progress Report of November, 1972 to the President and Congress says

at page 42: "Areas in which the daytime outdoor median noise level exceeds the range of 56 to 60 decibels, catagorized as 'noisy urban', are not well suited to detached residential housing."

"Areas in which the daytime outdoor median level exceeds 66 decibels are not suited to apartment living unless the buildings are air-conditioned, so that the windows may be kept closed to enable conversation indoors. If the outdoor median noise levels are above 71 decibels, special soundproofing is necessary to preserve the indoor noise environment."

at page 43: "...approximately 22 to 44 million people have lost part of the utility of their dwellings and yards to noise from traffic and aircraft on a continuing basis."

at page 43: "...[N]oise appears to affect at least 80 million people, or 40 percent of the population. Roughly one-half of the total impact of noise represents a potential health hazard (in terms of hearing impairment alone), and the remaining half represents an infringement on the ability to converse in the home."

The Sunnyvale Municipal Code §10-3.402 - Noise or Sound

Reproduced from best available copy.

residential property line. The Palo Alto Noise Ordinance provides that no noise at a property line shall be more than 6 dBA above the ambient level; the ambient level in Palo Alto residential neighborhoods is in the range 38 to 40 dBA during the day.

Residents in typical cities of the area have expressed by citizen action their displeasure over being subjected to noise of greater than 50 dBA. Thus Los Altos residents along Foothill Expressway taxed themselves in a noise abatement assessment district to build a masonry wall to reduce the impact of traffic noise from 70 to 50 dBA, some of them paying an assessment as high as $1,000. In similar vein residents of Woodside (not impacted by P-3 training flights but a nearby residential community of of similar character) experiencing commerical jet over-flights headed to and from San Francisco Airport which subjected them to noise bursts of 50 to 70 dBA, sued the airport, airlines and FAA for relief and eventually the overflying routes were modified to reduce the noise impact.

The data offered in Attachments 4 and 5 show that the P-3 training flights are imposing an overburden of up to 30 decibels near the flight practice pattern to up to 20 decibels five miles away. Approximately 340,000 people live in a circle of a ten-mile radius from Moffett Field with probably more than half within a five-mile radius. On these people, the training flights impose this 20 to 30 decibel noise over-burden, where a 6 decibel burden is the maximum allowed in typical ordinances (e.g., the Palo Alto ordinance). Viewed in another way the Navy imposes a level of from 60 up to 80 dBA where a typical ordinance specifies a maximum level of 50 dBA (the Sunnyvale ordinance).

Clearly, by California residential standards this noise impact is intolerable. The effect on the residents themselves is attested in three attached declarations (Attachments 6(a), 6(b), 6(c)) of citizens whose homes lie under the pathways of the planes. The extreme adverse effect of these flights on the peace, security, and quiet of their homes is attested to by these declarations. The Environmental Protection Agency Region IX has provided the information that complaints about the excessive noise from Moffett Field's flights were consistenty received by their office during the month of August, 1971 when they sponsored a noise complaint telephone line to determine areas with particular noise problems. Of 385 complaints, sixty protested the noise from the Moffett Field training flights.

IV. SAFETY

It has become uncomfortably clear in recent months, particularly after the crash into an Alameda (California) apartment building of a Navy A7 Corsair flying a training flight on February 7, 1973, that the safety of military training flight operations is not to be taken for granted.

Under the P-3 flight pattern are thousands of residences and apartment buildings. Under this flight pattern are more than thirty-five schools. The planes fly at maximum altitudes of 1,000 to 1,500 feet, and during the landing and take-off phases must fly even lower. Not only are United States Navy aviators being trained in these flights but foreign aviators as well (see Attachment 7, which is a press article describing the training of Spanish aviators at Moffett Field). Since the P-3 operations began at Moffett Field, two accidents or incidents involving P-3's have occurred, with no damage to property or injuries to civilian population in either case. On 12 April 1968, a P-3 owned and operated by the Australian Royal Air Force crashed on landing. On 27 May 1972, a Moffett Field P-3 Orion patrol plane (not flying the circular training pattern) failed to return and is still missing. This is a relatively good safety record, but it is obvious that no massive flying operation, and especially one involving training, is a perfectly safe operation, and each of the 50,000 to 60,000 flights per year over this area carries the possibility of disaster for the civilian population .

V. AIR POLLUTION

Moffett Field is in a part of Santa Clara Valley of California which has a high susceptibility to extreme air pollution. For an analysis see Aviation Effect On Air Quality In The Bay Region, prepared for the Regional Airport Systems Study of the Association of Bay Area Governments by the Bay Area Air Pollution Control District, February, 1971. At page II-5 their report indicates that Moffett Field is an area which has a scale of between IV and V, where the scale has been devised to rate air pollution potential on the basis of meteorogical restraints and projected contaminant emission rates. IV describes heavy air pollution potential, with State standards for all contaminants frequently exceeded. V represents severe air pollution potential, with State standards for all contaminants frequently exceeded by very substantial amounts. (See page II-4).

There are 18.7 tons per day of emissions from aircraft operating at Moffett Field. This figure was obtained by computation from Note 3 of Table VI-2. At this rate Moffett Field exceeds the aircraft emissions of any of the seven Bay Area airports (San Francisco, Oakland, San Jose, Alameda, Hamilton, and Travis) with the exception of San Francisco International Airport . It emits almost twice as many tons per day of air polluting material as the civilian nearby San Jose Airport.

Selected quotations from the B.A.A.P.C.D. report discussing the pollution potential of the area follow:

at page IX-7 : "Pollution potential of the Santa Clara Valley is high during the entire year. By virtue of its location down wind of the major urban centers, the Valley is a receptor for Bay Area pollutants. The background level is therefore already high, aside from any local contribution."

at page IX-9: "As a result of the characteristic Valley stability and lateral mixing contraints, plus one of the highest frequencies for the low wind speed range in the entire Bay Area, the Mountain View area [which adjoins Moffett Field] has high pollution potential."

That the P-3's contribute substantially to the air pollution is easily verified by sight. The aircraft trail an oily residue which not only pollutes the air but contaminates the homes over which they fly (see Declaration, Appendix 6(b)).

VI. SUMMARY

The serious effects of noise on the health and welfare of citizens of the United States is now recognized, one of the recent embodiments of this recognition being in the United States Noise Control Act of 1972. What was once argued by noise-makers to be an acceptable level of noise is now seen to be unacceptable. The citizens of the five cities of Los Altos, Los Altos Hills, Mountain View, Palo Alto and Sunnyvale are subjected to a continuouse environmental insult by the training operations at the U.S. Naval Air Station, Moffett Field, California.

It is no good to argue, as the Navy has on occasion with respect to Moffett Field, that the airfield was there before the residences were. In the first place, the residential areas were zoned and substantially inhabited before the noisy operations of the Navy began.

In the second place, it is unreasonable to put the burden of living with an environmental insult on people who need housing. If governments, whether local or federal, choose to zone or allow to be zoned land as residential areas, they are thereby undertaking the responsibility for assuring that such land is suitable for residences. The residential zoning is a fact accomplished. Nothing can undo this except purchase by the federal government of all homes affected. Since the cities involved and the federal government allowed houses to be built and people to live in them, they have a responsibility to make the area appropriate for California living under the standards of similar Northern California communities.

Since the part of Santa Clara Valley in the area of the southern end of San Francisco Bay is a critical air pollution zone, the contribution of the continual flying operations of the Navy in this area must be regarded unfavorably, and the burden put upon the polluter to justify his activities. Penalties and restrictions are now imposed on civilians in California, both on businesses and on private activities, and further severe restrictions are contemplated in order to reduce air pollution to acceptable levels. The United States Navy must recognize its responsibility to assist in reducing such pollution by removing the massive flying operation from this critical area.

Finally, the danger to residents and to school children of accidents during training flights is so obvious and so distressing to contemplate as to give one a sense of helplessness and pointlessness in even calling it to attention. It is entirely inappropriate to conduct a massive flying operation in the very middle of a residential area. If and when an accident with loss of civilian lives does occur the failure of the United States Navy and of the municipalities concerned to recognize the problem when it was there for all to see and to remedy it before harm was done, will be a burden on the consciences of these authorities.

For all these reasons, the residents whom the writer represents respectfully request the United States Navy to move its flight training operations away from Moffett Field to areas more suitable for such activities.

Marjorie W. Evans

MARJORIE W. EVANS
Danaher, Gunn & Klynn
Attorneys At Law
2600 El Camino Real
Palo Alto, California 94306

cc: U. S. Senator Alan Cranston
U. S. Senator John Tunney
U. S. Congressman Paul McCloskey
California Air Resources Board
California Attorney General Evelle J. Younger
Environmental Protection Agency, Region IX

ATTACHMENT 1

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA 94035

IN REPLY REFER TO:
A:lak
DEC 7 1970

Marjorie W. Evans
14511 De Bell Drive
Los Altos, California 94022

Dear Mrs. Evans:

We have been authorized to provide you with the specific information concerning aircraft operations at Moffett Field you requested on August 12, 1970.

The average number of operations, which in this context refers to a landing, take-off, touch-and-go, or low pass, are as follows:

	1968	1969	1970
Per weekday	322	312	316
Per Saturday or Sunday	192	135	130
Per month	10,117	9,437	9,607
Per year	121,402	113,041	115,000

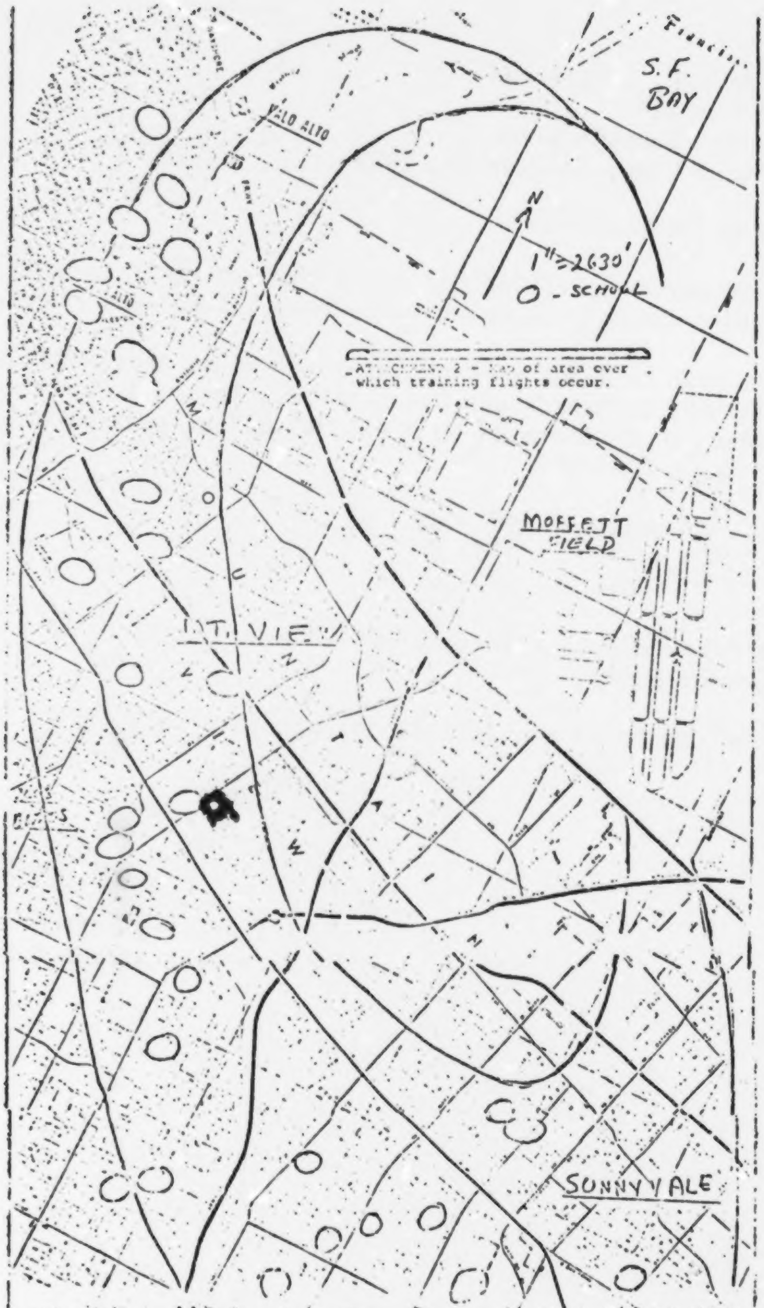
Aircraft in the local traffic pattern remain generally over the cities of Mountain View and Sunnyvale, and very seldom operate over Palo Alto or farther north due to possible conflict with traffic in the Palo Alto Airport traffic area.

Your interest in the Navy is appreciated.

Sincerely,

F. T. Stephens

F. T. STEPHENS
Captain, U.S. Navy
Commanding Officer



ATTACHMENT 2 - Map of area over which training flights occur.

Francisco
S.F. BAY
PALO ALTO
ALTO
N
1" = 2630'
O - SCHOOL
MOFFETT FIELD
MT. VIEW
MOUNTAIN VIEW
SUNNYVALE
N
N

ATTACHMENT 3

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA 94035

IN REPLY REFER TO:
00D:rvb
5720
10 December 1971

DEC 1[illegible] 1971

DISCARD ☐ FILE ☐

Mr. John T. O'Halloran
City Manager
City of Mountain View
Mountain View, California, 94040

Dear Mr. O'Halloran:

The Commanding Officer has asked that we reply to your letter requesting noise measurement data from NAS Moffett Field.

The sound readings were gathered for us by the SAGES Group of the Lockheed MSC Management Association. The measurement of decibels of the noise generated by a P-3 "Orion" at peak power during take off is as follows:

"A" scale	98	db
"B" scale	105	db
"C" scale	120+	db

The measurements were obtained at a point approximately 100 feet from the source.

If we can be of any further assistance please let us know.

Sincerely,

J R Shackleton

J. R. SHACKLETON
Public Affairs Officer
By direction of the Commanding Officer

ATTACHMENT 4(a)

Noise-Level vs. Distance for P-3 Orion Turbo-Prop Aircraft

Date	Approx. Time	Distance	Plane Activity	Background (dB)			Noise Level (dB)		
				A	B	C	A	B	C
--		100 feet	Takeoff				98	105	120+(a)
1/14/72	1630	1 mile (c)	Prop. Reversal				60	70	80
"	1630	"	"				64	72	84
8/22/71	1800	5 miles (d)	Takeoff (b)	45		53	45		62-64
8/23/71	0700	"	"	48-54		59-61	51		69
"	2200	"	"	44		54	52		64
8/24/71	0730	"	"	48-50		58-60	48-50		70-75
8/25/71	2130	"	"	42		55	46-48		72-78
1/6/72	1030	"	"	48	51	60	52	(70?)	80

(a) Information from Attachment 3.

(b) The activities are believed to be takeoffs, but the 5-mile distance and the close spacing of the planes in the landing and takeoff pattern (one every 2 or 3 minutes) introduce the possibility that some of these may have been prop reversals.

(c) Same elevation as aircraft, which was in line of sight.

(d) 225 feet higher than the airfield to the southwest, with the airfield in line of sight (thought not necessarily the aircraft, which could be behind buildings on the field).

ATTACHMENT 4(D)

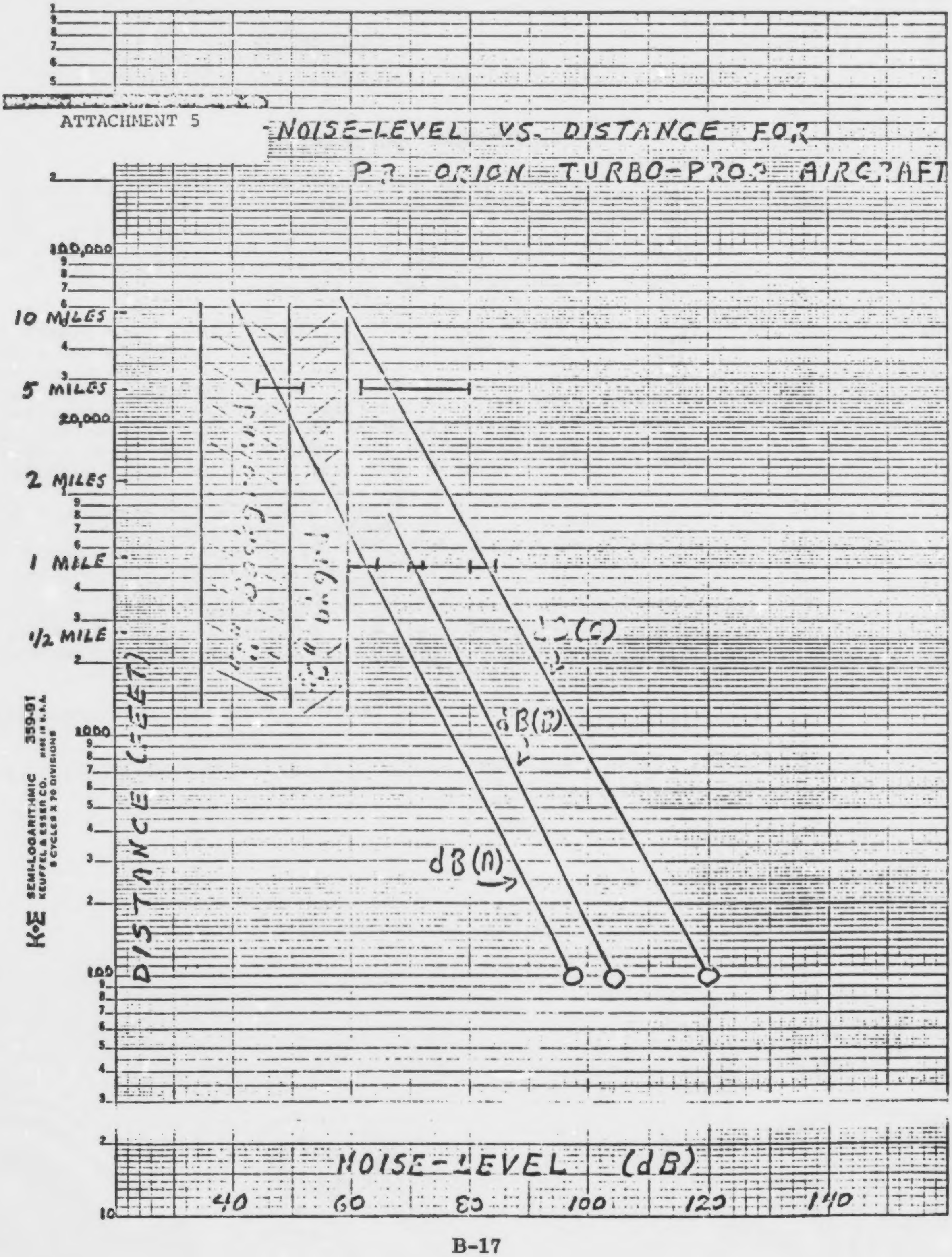
Typical Noise Levels and Frequencies of Noise Impact in Residential Areas Generated by P-3 Orion Turbo-Prop Overhead or Nearby Flights

Date	Time	Location	Noise-Level		Quiet Background		Frequency of Flights
			dBA	dBC	dBA	dBC	
7/31/72	1225-1310	Sunnyvale, California Pippin Drive near Pippin Elementary Sch.	68-80	82-91	52	63	Every 1.5 mins
7/31/72	1320-1340	Sunnyvale, California near Shopping Center at Mathilda near Evelyn	81-83	80-95	50-60	68-73	Every 1.4 mins
1/31/73	1745-1800	Palo Alto, California Residential area near Charleston and Middlefield	60-72	72-80	48-55	66-68	Every 5 mins.

Reproduced from
best available copy.

ATTACHMENT 5

NOISE-LEVEL VS. DISTANCE FOR P3 ORION TURBO-PROP AIRCRAFT



DECLARATION

I, [redacted], declare:

Since about 1968, navy planes engaged in practicing touch-and-go landings have been circling over our community at an average rate of several hundred flights every day. Most of these fly directly over my house at an altitude of less than 1000 feet. The training has often extended long into the night -- sometimes as late as midnight.

The noise created by one of these Orion planes is bad, but the noise occurring at thirty-second to two-minute intervals for an entire day is intolerable. Each plane leaves trails of black fumes. Each causes TV pictures to roll and distort. The walls of the house often rattle and vibrate. Worst of all is the danger of catastrophe. With so many low level flights every day, a catastrophic crash seems inevitable. The path of the planes lies over more than thirty schools.

The effect of these flights is to make life difficult and unpleasant. One has to stop talking and thinking each time a plane passes. Concentration on a mental task is impossible. Children report that teachers either have to stop talking or cannot be heard. A full day of flying leaves one nervous, upset, and frustrated. Other effects are depression of the value of our property and difficulty in selling houses, an increase in the pollution of our air, and concern over the safety of our children.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 20 day of February, 1973, at Sunnyvale, Ca., California.

ATTACHMENT 6(b)

where I live, is part of Sunnyvale's densely populated R-1 and R-0 residential areas which are directly under the training flight pattern used by the Navy to train pilots to take off and land P-3 Orion four-motored turbo prop planes. This training flight pattern is also used on occasion by jet fighters, twin engined observer-type service planes as well as by some NASA equipment.

Not only does Moffett Field train its pilots over this flight pattern but reservists and other pilots use it to get in required flying time; and now, forty-five pilots from a foreign country are stationed at Moffett Field to be trained in the use of P-3 Orions.

When one considers the fact that these planes often fly low over our houses from mid-morning until dark (and sometimes until nearly midnight) and sometimes at the rate of one at about every sixty seconds, it is not hard to imagine their impact on those living below this training flight pattern. As Sunnyvale is under the descending portion of the pattern, these planes thunder overhead at far less than 1,000 feet altitude and when coming at the rate of one every minute the roar of one is hardly diminished before the crescendo of the next shatters the air.

The effect of this noise on the environment of our neighborhood is, in part, as follows:

As lunch and dinner times are popular training times, use of our patio for meals is out of the question. Grandchildren can take no afternoon naps at our house. Conversations in the yard are impossible when the Orions are flying this residential flight pattern and if windows and doors are open even telephone conversations must be interrupted to allow passage of the planes.

Air pollution must be considerably increased when the Orions are laying down four black exhaust streamers at close intervals. In forty years of housekeeping my wife has never before had to contend with such problems as black, gummy deposit on furniture left behind by the planes. I have a small light blue station wagon which must be parked on the drive with the result that the top and the hood are speckled with black tar most of the time.

The training flight pattern takes in land in Palo Alto, Mountain View, and Sunnyvale on which over thirty schools are located. Not only does the thunder of these planes interfere with classes but consider what would happen if human or mechanical failure resulted in a crash landing by one of the low-flying planes onto a school building or play yard. The Navy and the public are indeed fortunate that this has not happened before now.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: February 11, 1973.

ATTACHMENT 6(c)

DECLARATION

The Moffett Field training flights fly near or directly over our home almost daily.

These flights are approximately 1 minute 15 seconds apart.

These flights often occur in the eveing when our children are trying to sleep.

The noise on our patio or in our home is very annoying.

Our windows often vibrate from the planes.

Our children's school is often in the direct flight pattern.

Other schools, parks, libraries, shopping centers and companies are in the flight pattern as well as thousands of private dwellings.

The Navy needs to consider the welfare of the people of this area and relocate their "touch and go" training flights to a less populated area.

February 1, 1973.

Training Goes 'Foreign' At Moffett

MOFFETT FIELD — An international team has gathered together at Moffett Field under two different programs aimed at improving and coordinating antisubmarine maneuvers.

The first of the Navy-conducted programs is an exchange program involving the United States, Australia, Canada and Britain. American officers are sent to other participating nations to explain the U.S. sub-hunting program. procedures.

In turn, officers from those nations are sent to U.S. bases to interpret their countries' procedures.

The second program trains foreign pilots to fly the Lockheed Orion aircraft purchased by their countries.

Ironically, the program's instructor is Flight Lt Phillip Presgrave of the Royal Australian Air Force.

A contingent of 45 Spanish Air Force personnel arrived here at the beginning of the month after Spain arranged to purchase three Orions. They'll train until July.

The trainees flanked high-ranking Spanish Air Force officers Monday at ceremonies for the acceptance of the planes.

In the exchange program, RAAF Wing Commander Colin Prior serves as schedules officer, while Major Leslie G. Osborne, Canadian Forces (Air) is a pilot and naval flight officer, and Royal Air Force Flight Lt. John Harris is a tactical development group officer.

According to a Moffett Field spokesman, the programs can be differentiated easily.

"In training, "he said," the personnel are functioning as officers of their own country. In the exchange program, they are functioning as American officers."

SAN JOSE NEWS
★★★ SAN JOSE, CALIFORNIA, WEDNESDAY, JANUARY 17, 1973

Students For Orion

Forty-five Spanish Air Force officers will learn to fly the Navy's Orion P-3 sub-hunter aircraft at Moffett Field Naval Air Station. Three of the huge craft were purchased recently by the Spanish government. The officers, shown in acceptance ceremonies Monday, will train until July. (Staff Photo)

MARJORIE W. EVANS
LAWYER
Suite 506
2600 EL CAMINO REAL, PALO ALTO, CALIFORNIA 94306 TELEPHONE (415) 326-1141

2 April 1973

Raelyn Janssen
Environmental Defense Fund
1712 N Street NW
Washington, D.C. 20036

Dear Raelyn:

In accordance with our conversation last Friday I am sending you this information about difficulties citizens in California are having with noise generated by military airports and aircraft. I will appreciate it if you will use this information as you see fit in connection with the meetings of Task Group VI (Military Airports/Aircraft) of the EPA Aircraft/Airport Noise Study Group.

Two kinds of problems have appeared. The appearance of each suggests that some new institutional control should be set up over the noise-making activities of military air operations when that activity impacts civilian areas, and particularly residential areas.

The first problem is the conventional one of noisy air operations over residential areas. I am sending you a detailed description of such a situation caused by operations of the U.S. Naval Air Station at Moffett Field, California. These operations are carried out over areas which were zoned and occupied by residences long before the Navy began air operations having even remotely the impact of the present ones. The problem is that there is no unbiased, outside authority to consider the citizens' plight. The military not only makes the noise, but judges the severity of the nuisance (which it judges in this case to be slight).

The second problem is novel, I believe. Castle Air Force Base, near Merced, California, has recently published a noise contour map purporting to describe the noise contours around the Field, which is used for B-52 flights. The Air Force does not contend in this case that the air operations are not noisy. To the contrary the citizen complaint here is that the Air Force has drawn high noise contours even in areas where the noise was not particularly high. The result is that HUD Guidelines come into play and much undeveloped land has been withdrawn from lists of FHA finance permission. The local people believe that the Air Force has extended its noise influence further than its activities actually warrant. In this case, too, it appears that an unbiased third-party agency is needed to make noise measurements and determine for a skeptical citizenry just how far the military control of land development should extend.

Yours truly,

Marjorie W Evans

MWE:lw
enc.

ENVIRONMENTAL AND SAFETY ASPECTS OF P-3 ORION FLIGHT TRAINING PROGRAM AT U.S. NAVAL AIR STATION, MOFFETT FIELD, CALIFORNIA

March 7, 1973

Marjorie W. Evans

I. BACKGROUND

II. GEOGRAPHY

III. NOISE IMPACT

IV. SAFETY

V. AIR POLLUTION

VI. SUMMARY

Attachments:

1. Letter from U. S. Navy stating number of P-3 training flight operations at Moffett Field.
2. Map of area over which training flights occur.
3. Letter from U.S. Navy giving noise data.
4. (a, b) Tables giving noise measurements.
5. Graph displaying noise impact on neighboring areas.
6. (a, b, c) Declarations from affected citizens relative to adverse impact of Navy training operations.
7. News article relating training of Spanish aviators at Moffett Field.

March 7, 1973

ENVIRONMENTAL AND SAFETY ASPECTS OF P-3 ORION FLIGHT TRAINING PROGRAM AT U.S. NAVAL AIR STATION, MOFFETT FIELD, CALIFORNIA

(a) Submitted for inclusion as part of the study being prepared for the U.S. Navy on the impact of flying operations on neighboring communities near Moffett Field.

(b) Submitted to Federal Environmental Protection Agency, Aircraft/Airport Noise Study, Task Force on Military Aircraft/Airports.

I. BACKGROUND

The U.S. Naval Air Station at Moffett Field, Sunnyvale, California was a jet aircraft base in the 1950's. There was public concern at that time over the danger to the public generated by jet aircraft traffic, (a warranted concern, since in 1960-61 there were five nearby Moffett-related crashes and one civilian ground casualty in Mountain View) and the noise impact of the operations on the neighboring residential communities. Because of these two concerns the Navy removed the major portion of the jet activity from Moffett Field upon the construction of Lemoore Airfield in September, 1961. The base became the Pacific headquarters of anti-submarine patrol squadrons, which utilize P-3 Orion four-engine turbo-props. From 1961 to 1968 there was little hazardous or polluting flying activity by the Navy over the neighboring residential communities, and opposition to the presence of the Navy in the community was nearly if not totally nonexistent.

However, in 1968 the base was established as the location for crew training in the P-3 aircraft, and this massive training program brought back the old noise and safety problems in much more virulent form. A major portion of this program (from the point of view of the community) involves the flying of these aircraft on an elliptical path, with axes of approximately four and eight miles, around the field at an altitude of zero to 1,500 feet making touch-and-go landings on the airstrip (as well as the associated aircraft warm-up operations). In general the same plane and crew circles many times, making a landing and take off in each pass around the field. There are frequently two to three planes in a pattern, and a fly-over every one and one-half minutes is common at many residences. In this way, between 114,000 and 121,000 take-off and landings, i.e., between 57,000 and 60,500 patterns, are flown per year (see Attachment 1). Thus, the noise and danger problem removed from the community in 1961 was reimposed in 1968 in the form of a 7-day a week, 18-hours a day (from 6 a.m. to midnight) noise, air pollution, and safety problem.

II. GEOGRAPHY

The path followed by the planes in their circling training flights is shown on the map given as Attachment 2, where the solid lines delineate what appear to this writer to be the region of concentration of the flights. Planes have been observed flying the pattern outside the indicated path, e.g., at a place marked by a cross. Much of the flight pattern is over residential areas in the Cities of Los Altos, Mountain View, Palo Alto, and Sunnyvale. These residential areas were largely so zoned and were well established residential areas in the 1940's and 1950's, with some plots being so zoned as late as the middle 1960's.

There are thirty-five schools lying under the path of concentrated flying use, and many more in the larger area over which planes have been observed. These schools are marked by circles on Attachment 2.

The area of the noise impact extends far beyond the flight pattern, to a radius of five miles or more. Data is given on the next section. While a part of this area is water, (San Francisco Bay) the number of citizens in the noise-impacted area is 200,000 or more.

III. NOISE IMPACT

Noise measurements were made by the author at distances of one mile and five miles from the field. Measurements of the noise generated by the P-3's at 100 feet have been supplied by the Navy (see Attachment 3). The instrument used by the author was a General Radio Company 1565-A Sound-Level Meter. The instrument was calibrated at frequent intervals. It has a range of 38 to 140 dB and has the capability of measuring on A-, B-, and C-weighted scales.

While it is common practice to measure noise levels on the A scale on the assumption that low frequencies are less annoying than high frequencies, in the author's opinion this scale used alone is not appropriate in the case of the P-3's. The reason is that these turbo-props have a heavy component of low frequency sound waves which carry very large distances and which are extremely annoying to many people. Use of the A-scale filters out the low frequency component to a considerable extent, and understates the noise impact from these aircraft. For these reasons the author's measurements include both A- and C-weighted measurements. Data are shown in table form (Attachments 4(a) and 4(b)) and in graph form (Attachment 5). Attachment 4(a) gives data for noise levels versus distance for the aircraft. Attachment 4(b) gives noise levels measured in selected residential areas.

The graph (Attachment 5) is a semi-log plot of the noise level versus distance for these aircraft. Superimposed upon the straight lines which are drawn as an approximation between the data points are the background levels measured in the absence of the P-3 noise, with both A scale and C scale values being shown. The P-3's are seen to impose an average 8 dBA and 18 dBC noise burden on the community at a distance of two miles from the field, and a 4 to 22 dBC burden even at five miles. The variation is probably due to aircraft variation and to meteorology.

It is pertinent to examine the standrads of the communities to determine if this noise burden, which ranges up to 30 decibels at various parts of the residential area, should be viewed as a substantial environmental insult.

Northern California communities in general set as a standard 50 dBA as the maximum tolerable outdoor noise for residential areas. A Report to the 1971 Legislature on the Subject of Noise, prepared by the Advisory Committee on Noise authorized by the California State Assembly under Concurrent Resolution 165, 1970 states that California residents living in suburban residential areas want a noise level no greater than 40 dBA by day and 30 dBA by night (at page 33). It goes on to state that residents of suburban residential communities will accept without undue complaint 40 to 50 dBA during the day and 30 to 40 dBA during the night (at page 34).

The U.S. Environmental Protection Agency in its Progress Report of November, 1972 to the President and Congress says

at page 42: "Areas in which the daytime outdoor median noise level exceeds the range of 56 to 60 decibels, catagorized as 'noisy urban', are not well suited to detached residential housing."

"Areas in which the daytime outdoor median level exceeds 66 decibels are not suited to apartment living unless the buildings are air-conditioned, so that the windows may be kept closed to enable conversation indoors. If the outdoor median noise levels are above 71 decibels, special soundproofing is necessary to preserve the indoor noise environment."

at page 43: "...approximately 22 to 44 million people have lost part of the utility of their dwellings and yards to noise from traffic and aircraft on a continuing basis."

at page 43: "...[N]oise appears to affect at least 80 million people, or 40 percent of the population. Roughly one-half of the total impact of noise represents a potential health hazard (in terms of hearing impairment alone), and the remaining half represents an infringement on the ability to converse in the home."

The Sunnyvale Municipal Code §10-3.402 - Noise or Sound Level provides that noise shall not exceed 50 decibels at any residential property line. The Palo Alto Noise Ordinance provides that no noise at a property line shall be more than 6 dBA above the ambient level; the ambient level in Palo Alto residential neighborhoods is in the range 38 to 40 dBA during the day.

Residents in typical cities of the area have expressed by citizen action their displeasure over being subjected to noise of greater than 50 dBA. Thus Los Altos residents along Foothill Expressway taxed themselves in a noise abatement assessment district to build a masonry wall to reduce the impact of traffic noise from 70 to 50 dBA, some of them paying an assessment as high as $1,000. In similar vein residents of Woodside (not impacted by P-3 training flights but a nearby residential community of of similar character) experiencing commerical jet over-flights headed to and from San Francisco Airport which subjected them to noise bursts of 50 to 70 dBA, sued the airport, airlines and FAA for relief and eventually the overflying routes were modified to reduce the noise impact.

The data offered in Attachments 4 and 5 show that the P-3 training flights are imposing an overburden of up to 30 decibels near the flight practice pattern to up to 20 decibels five miles away. Approximately 340,000 people live in a circle of a ten-mile radius from Moffett Field with probably more than half within a five-mile radius. On these people, the training flights impose this 20 to 30 decibel noise over-burden, where a 6 decibel burden is the maximum allowed in typical ordinances (e.g., the Palo Alto ordinance). Viewed in another way the Navy imposes a level of from 60 up to 80 dBA where a typical ordinance specifies a maximum level of 50 dBA (the Sunnyvale ordinance).

Clearly, by California residential standards this noise impact is intolerable. The effect on the residents themselves is attested in three attached declarations (Attachments 6(a), 6(b), 6(c)) of citizens whose homes lie under the pathways of the planes. The extreme adverse effect of these flights on the peace, security, and quiet of their homes is attested to by these declarations. The Environmental Protection Agency Region IX has provided the information that complaints about the excessive noise from Moffett Field's flights were consistenty received by their office during the month of August, 1971 when they sponsored a noise complaint telephone line to determine areas with particular noise problems. Of 385 complaints, sixty protested the noise from the Moffett Field training flights.

IV. SAFETY

It has become uncomfortably clear in recent months, particularly after the crash into an Alameda (California) apartment building of a Navy A7 Corsair flying a training flight on February 7, 1973, that the safety of military training flight operations is not to be taken for granted.

Under the P-3 flight pattern are thousands of residences and apartment buildings. Under this flight pattern are more than thirty-five schools. The planes fly at maximum altitudes of 1,000 to 1,500 feet, and during the landing and take-off phases must fly even lower. Not only are United States Navy aviators being trained in these flights but foreign aviators as well (see Attachment 7, which is a press article describing the training of Spanish aviators at Moffett Field). Since the P-3 operations began at Moffett Field, two accidents or incidents involving P-3's have occurred, with no damage to property or injuries to civilian population in either case. On 12 April 1968, a P-3 owned and operated by the Australian Royal Air Force crashed on landing. On 27 May 1972, a Moffett Field P-3 Orion patrol plane (not flying the circular training pattern) failed to return and is still missing. This is a relatively good safety record, but it is obvious that no massive flying operation, and especially one involving training, is a perfectly safe operation, and each of the 50,000 to 60,000 flights per year over this area carries the possibility of disaster for the civilian population .

V. AIR POLLUTION

Moffett Field is in a part of Santa Clara Valley of California which has a high susceptibility to extreme air pollution. For an analysis see Aviation Effect On Air Quality In The Bay Region, prepared for the Regional Airport Systems Study of the Association of Bay Area Governments by the Bay Area Air Pollution Control District, February, 1971. At page II-5 their report indicates that Moffett Field is an area which has a scale of between IV and V, where the scale has been devised to rate air pollution potential on the basis of meteorogical restraints and projected contaminant emission rates. IV describes heavy air pollution potential, with State standards for all contaminants frequently exceeded. V represents severe air pollution potential, with State standards for all contaminants frequently exceeded by very substantial amounts. (See page II-4).

There are 18.7 tons per day of emissions from aircraft operating at Moffett Field. This figure was obtained by computation from Note 3 of Table VI-2. At this rate Moffett Field exceeds the aircraft emissions of any of the seven Bay Area airports (San Francisco, Oakland, San Jose, Alameda, Hamilton, and Travis) with the exception of San Francisco International Airport . It emits almost twice as many tons per day of air polluting material as the civilian nearby San Jose Airport.

Selected quotations from the B.A.A.P.C.D. report discussing the pollution potential of the area follow:

at page IX-7 : "Pollution potential of the Santa Clara Valley is high during the entire year. By virtue of its location down wind of the major urban centers, the Valley is a receptor for Bay Area pollutants. The background level is therefore already high, aside from any local contribution."

at page IX-9: "As a result of the characteristic Valley stability and lateral mixing contraints, plus one of the highest frequencies for the low wind speed range in the entire Bay Area, the Mountain View area [which adjoins Moffett Field] has high pollution potential."

That the P-3's contribute substantially to the air pollution is easily verified by sight. The aircraft trail an oily residue which not only pollutes the air but contaminates the homes over which they fly (see Declaration, Appendix 6(b)).

VI. SUMMARY

The serious effects of noise on the health and welfare of citizens of the United States is now recognized, one of the recent embodiments of this recognition being in the United States Noise Control Act of 1972. What was once argued by noise-makers to be an acceptable level of noise is now seen to be unacceptable. The citizens of the five cities of Los Altos, Los Altos Hills, Mountain View, Palo Alto and Sunnyvale are subjected to a continuouse environmental insult by the training operations at the U.S. Naval Air Station, Moffett Field, California.

It is no good to argue, as the Navy has on occasion with respect to Moffett Field, that the airfield was there before the residences were. In the first place, the residential areas were zoned and substantially inhabited before the noisy operations of the Navy began.

In the second place, it is unreasonable to put the burden of living with an environmental insult on people who need housing. If governments, whether local or federal, choose to zone or allow to be zoned land as residential areas, they are thereby undertaking the responsibility for assuring that such land is suitable for residences. The residential zoning is a fact accomplished. Nothing can undo this except purchase by the federal government of all homes affected. Since the cities involved and the federal government allowed houses to be built and people to live in them, they have a responsibility to make the area appropriate for California living under the standards of similar Northern California communities.

Since the part of Santa Clara Valley in the area of the southern end of San Francisco Bay is a critical air pollution zone, the contribution of the continual flying operations of the Navy in this area must be regarded unfavorably, and the burden put upon the polluter to justify his activities. Penalties and restrictions are now imposed on civilians in California, both on businesses and on private activities, and further severe restrictions are contemplated in order to reduce air pollution to acceptable levels. The United States Navy must recognize its responsibility to assist in reducing such pollution by removing the massive flying operation from this critical area.

Finally, the danger to residents and to school children of accidents during training flights is so obvious and so distressing to contemplate as to give one a sense of helplessness and pointlessness in even calling it to attention. It is entirely inappropriate to conduct a massive flying operation in the very middle of a residential area. If and when an accident with loss of civilian lives does occur the failure of the United States Navy and of the municipalities concerned to recognize the problem when it was there for all to see and to remedy it before harm was done, will be a burden on the consciences of these authorities.

For all these reasons, the residents whom the writer represents respectfully request the United States Navy to move its flight training operations away from Moffett Field to areas more suitable for such activities.

Marjorie W. Evans

MARJORIE W. EVANS
Danaher, Gunn & Klynn
Attorneys At Law
2600 El Camino Real
Palo Alto, California 94306

cc: U. S. Senator Alan Cranston
U. S. Senator John Tunney
U. S. Congressman Paul McCloskey
California Air Resources Board
California Attorney General Evelle J. Younger
Environmental Protection Agency, Region IX

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA 94035

IN REPLY REFER TO:
A:lak
DEC 7 1970

Marjorie W. Evans
14511 De Bell Drive
Los Altos, California 94022

Dear Mrs. Evans:

We have been authorized to provide you with the specific information concerning aircraft operations at Moffett Field you requested on August 12, 1970.

The average number of operations, which in this context refers to a landing, take-off, touch-and-go, or low pass, are as follows:

	1968	1969	1970
Per weekday	322	312	316
Per Saturday or Sunday	192	135	130
Per month	10,117	9,487	9,607
Per year	121,402	113,841	115,000

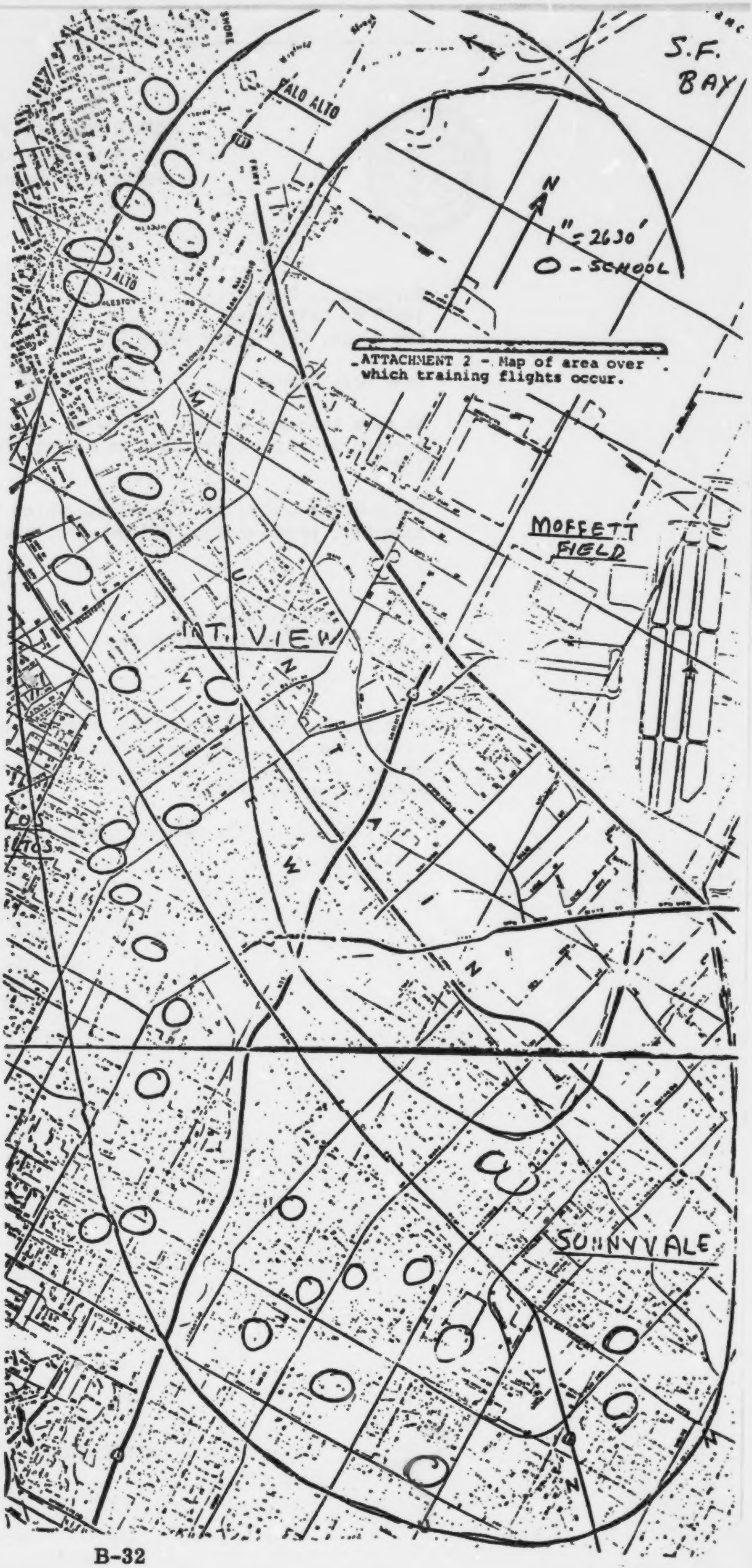
Aircraft in the local traffic pattern remain generally over the cities of Mountain View and Sunnyvale, and very seldom operate over Palo Alto or farther north due to possible conflict with traffic in the Palo Alto Airport traffic area.

Your interest in the Navy is appreciated.

Sincerely,

F. T. Stephens

F. T. STEPHENS
Captain, U.S. Navy
Commanding Officer


S.F. BAY
PALO ALTO
N
1" = 2630'
O - SCHOOL
MOFFETT FIELD
MT. VIEW
LOS ALTOS
SUNNYVALE

ATTACHMENT 2 - Map of area over which training flights occur.

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA 94035

IN REPLY REFER TO:
00D:rvb
5720
10 December 1971

DEC [illegible] 1971

DISCARD ☐ FILE ☐

Mr. John T. O'Halloran
City Manager
City of Mountain View
Mountain View, California, 94040

Dear Mr. O'Halloran:

The Commanding Officer has asked that we reply to your letter requesting noise measurement data from NAS Moffett Field.

The sound readings were gathered for us by the SAGES Group of the Lockheed MSC Management Association. The measurement of decibels of the noise generated by a P-3 "Orion" at peak power during take off is as follows:

"A" scale	98	db
"B" scale	105	db
"C" scale	120+	db

The measurements were obtained at a point approximately 100 feet from the source.

If we can be of any further assistance please let us know.

Sincerely,

J. R. Shackleton
J. R. SHACKLETON
Public Affairs Officer
By direction of the Commanding Officer

ATTACHMENT 3

ATTACHMENT 4(a)

Noise-Level vs. Distance for P-3 Orion Turbo-Prop Aircraft

Date	Approx. Time	Distance	Plane Activity	Background (dB)			Noise Level (dB)		
				A	B	C	A	B	C
--		100 feet	Takeoff				98	105	120+(a)
1/14/72	1630	1 mile (c)	Prop. Reversal				60	70	80
"	1630	"	"				64	72	84
8/22/71	1800	5 miles (d)	Takeoff (b)	45		53	45		62-64
8/23/71	0700	"	"	48-54		59-61	51		69
"	2200	"	"	44		54	52		64
8/24/71	0730	"	"	48-50		58-60	48-50		70-75
8/25/71	2130	"	"	42		55	46-48		72-78
1/6/72	1030	"	"	48	51	60	52	(70?)	80

(a) Information from Attachment 3.

(b) The activities are believed to be takeoffs, but the 5-mile distance and the close spacing of the planes in the landing and takeoff pattern (one every 2 or 3 minutes) introduce the possibility that some of these may have been prop reversals.

(c) Same elevation as aircraft, which was in line of sight.

(d) 225 feet higher than the airfield to the southwest, with the airfield in line of sight (thought not necessarily the aircraft, which could be behind buildings on the field).

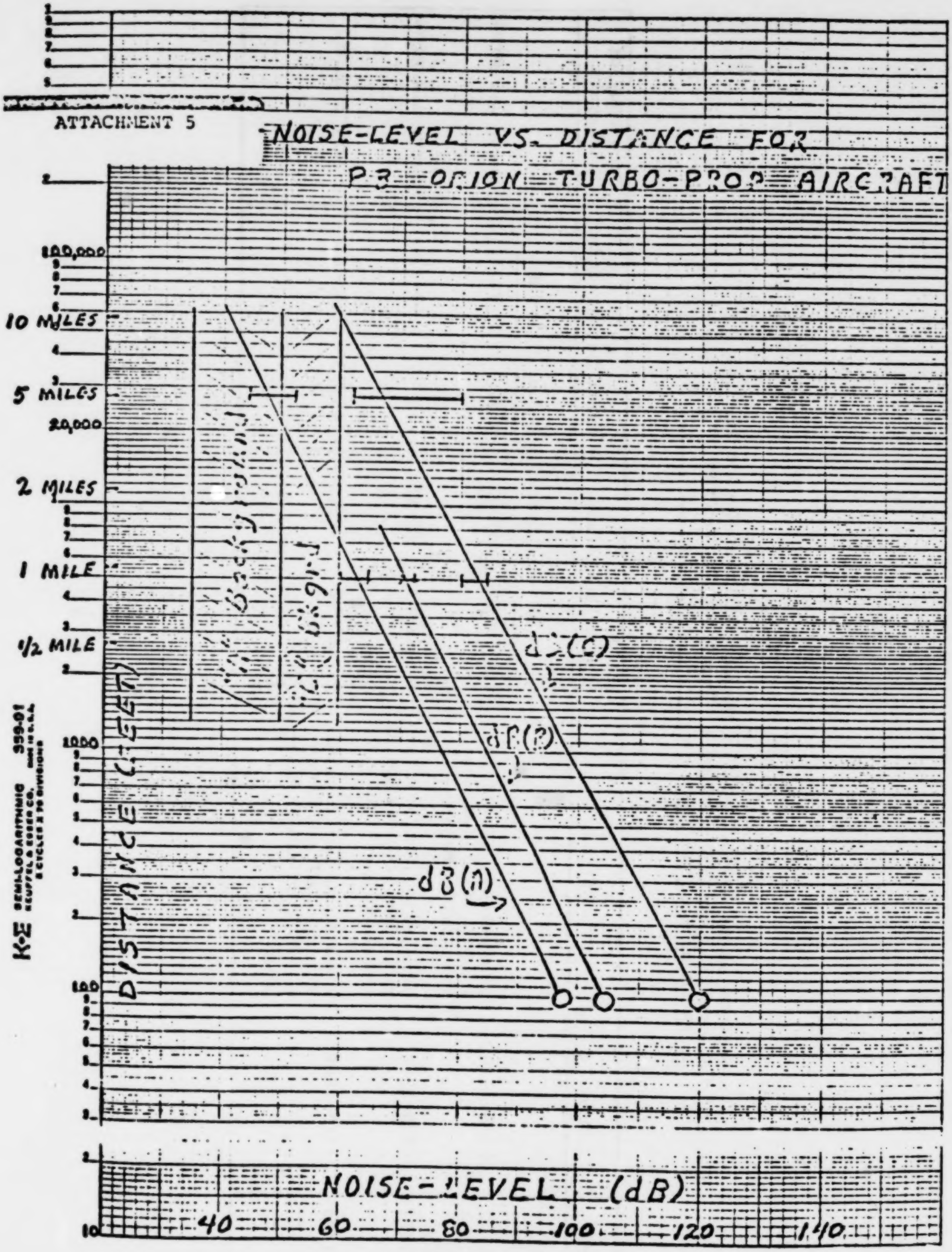
ATTACHMENT 4(b)

Typical Noise Levels and Frequencies of Noise Impact in Residential Areas Generated by P-3 Orion Turbo-Prop Overhead or Nearby Flights

Date	Time	Location	Noise-Level		Quiet Background		Frequency of Flights
			dBA	dBC	dBA	dBC	
7/31/72	1225-1310	Sunnyvale, California Pippin Drive near Pippin Elementary Sch.	68-80	82-91	52	63	Every 1.5 mins
7/31/72	1320-1340	Sunnyvale, California near Shopping Center at Mathilda near Evelyn	81-83	80-95	50-60	68-73	Every 1.4 mins
1/31/73	1745-1800	Palo Alto, California Residential area near Charleston and Middlefield	60-72	72-80	48-55	66-68	Every 5 mins.

ATTACHMENT 5

NOISE-LEVEL VS. DISTANCE FOR P3 ORION TURBO-PROP AIRCRAFT



ATTACHMENT 6(a)

DECLARATION

I, [redacted], declare:

Since about 1968, navy planes engaged in practicing touch-and-go landings have been circling over our community at an average rate of several hundred flights every day. Most of these fly directly over my house at an altitude of less than 1000 feet. The training has often extended long into the night -- sometimes as late as midnight.

The noise created by one of these Orion planes is bad, but the noise occurring at thirty-second to two-minute intervals for an entire day is intolerable. Each plane leaves trails of black fumes. Each causes TV pictures to roll and distort. The walls of the house often rattle and vibrate. Worst of all is the danger of catastrophe. With so many low level flights every day, a catastrophic crash seems inevitable. The path of the planes lies over more than thirty schools.

The effect of these flights is to make life difficult and unpleasant. One has to stop talking and thinking each time a plane passes. Concentration on a mental task is impossible. Children report that teachers either have to stop talking or cannot be heard. A full day of flying leaves one nervous, upset, and frustrated. Other effects are depression of the value of our property and difficulty in selling houses, an increase in the pollution of our air, and concern over the safety of our children.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 20 day of February, 1973, at Sunnyvale, California.

ATTACHMENT 6(b)

[redacted] where I live, is part of Sunnyvale's densely populated R-1 and R-0 residential areas which are directly under the training flight pattern used by the Navy to train pilots to take off and land P-3 Orion four-motored turbo prop planes. This training flight pattern is also used on occasion by jet fighters, twin engined observer-type service planes as well as by some NASA equipment.

Not only does Moffett Field train its pilots over this flight pattern but reservists and other pilots use it to get in required flying time; and now, forty-five pilots from a foreign country are stationed at Moffett Field to be trained in the use of P-3 Orions.

When one considers the fact that these planes often fly low over our houses from mid-morning until dark (and sometimes until nearly midnight) and sometimes at the rate of one at about every sixty seconds, it is not hard to imagine their impact on those living below this training flight pattern. As Sunnyvale is under the descending portion of the pattern, these planes thunder overhead at far less than 1,000 feet altitude and when coming at the rate of one every minute the roar of one is hardly diminished before the crescendo of the next shatters the air.

The effect of this noise on the environment of our neighborhood is, in part, as follows:

As lunch and dinner times are popular training times, use of our patio for meals is out of the question. Grandchildren can take no afternoon naps at our house. Conversations in the yard are impossible when the Orions are flying this residential flight pattern and if windows and doors are open even telephone conversations must be interrupted to allow passage of the planes.

Air pollution must be considerably increased when the Orions are laying down four black exhaust streamers at close intervals. In forty years of housekeeping my wife has never before had to contend with such problems as black, gummy deposit on furniture left behind by the planes. I have a small light blue station wagon which must be parked on the drive with the result that the top and the hood are speckled with black tar most of the time.

The training flight pattern takes in land in Palo Alto, Mountain View, and Sunnyvale on which over thirty schools are located. Not only does the thunder of these planes interfere with classes but consider what would happen if human or mechanical failure resulted in a crash landing by one of the low-flying planes onto a school building or play yard. The Navy and the public are indeed fortunate that this has not happened before now.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: February 11, 1973.

DECLARATION

The Moffett Field training flights fly near or directly over our home almost daily.

These flights are approximately 1 minute 15 seconds apart.

These flights often occur in the eveing when our children are trying to sleep.

The noise on our patio or in our home is very annoying.

Our windows often vibrate from the planes.

Our children's school is often in the direct flight pattern.

Other schools, parks, libraries, shopping centers and companies are in the flight pattern as well as thousands of private dwellings.

The Navy needs to consider the welfare of the people of this area and relocate their "touch and go" training flights to a less populated area.

February 1, 1973.

Training Goes 'Foreign' At Moffett

MOFFETT FIELD — An international team gathered together at Moffett Field under two different programs aimed at improving and oordinating antisubmarine maneuvers.

The first of the Navy-conducted programs is exchange program involving the United ates, Australia, Canada and Britain. Ameri- n officers are sent to other participating na- ns to explain the U.S. sub-hunting program. ocedures.

In turn, officers from those nations are sent U.S. bases to interpret their countries' ocedures.

The second program trains foreign pilots to the Lockheed Orion aircraft purchased by ir countries.

Ironically, the program's instructor is Flight Philip Presgrave of the Royal Australian Force.

A contingent of 45 Spanish Air Force onnel arrived here at the beginning of the nth after Spain arranged to purchase three ons. They'll train until July.

The trainees flanked high ranking Spanish Force officers Monday at ceremonies for the eptance of the planes.

In the exchange program, RAAF Wing ommander Colin Prior serves as schedules er, while Major Leslie G. Osborne, Canadi- Forces (Air) is a pilot and naval flight er, and Royal Air Force Flight Lt. John ris is a tactical development group officer.

According to a Moffett Field spokesman, the grams can be differentiated easily.

"In training, "he said," the personnel are tioning as officers of their own country. In exchange program, they are functioning as erican officers."

SAN JOSE NEWS
★★★ SAN JOSE, CALIFORNIA, WEDNESDAY, JANUARY 17, 1973

Students For Orion Forty-five Spanish Air Force officers will learn to fly the Navy's Orion P-3 sub-hunter aircraft at Moffett Field Naval Air Station. Three of the huge craft were purchased recently by the Spanish government. The officers, shown in acceptance ceremonies Monday, will train until July. (Staff Photo)

STOP N.O.I.S.E.
25 KNOB HILL ROAD, GLASTONBURY, CONNECTICUT 06033
203 - 633-2835
National Organization to Insure a Sound-controlled Environment

June 27, 1973

TO: Dr. Sidney J. Nethery, Chairman
Task Group 6
Aircraft/Airport Noise Report Study Task Force
U. S. Environmental Protection Agency
Washington, D. C. 20460

FROM: Lloyd Hinton, Executive Director, N.O.I.S.E.

SUBJ: Comments and Recommendations for Task Group 6 report to Congress.

In accordance with Mr. Schettino's request during the Task Force meeting on June 21 and 22, I am submitting this new response to replace that transmitted to you April 2, 1973, which is included in Appendix B of the draft report dated June 1, 1973.

The following comments relate unavoidably to the June 1, 1973 draft report and include recommendations for additional actions to strengthen the EPA report to the Congress. In the draft report which is obviously written by DOD rather than EPA personnel, excessive reliance is placed upon the value of programs for controls on land use in the vicinity of military airports while inadequate attention is devoted to measures for source control. Unaccountably, no attention is given to current situations existing at a large number of airports referred to as "joint use" fields. This trend toward joint civil-military airports will certainly continue.

A second more generalized criticism of the draft report is the lack of coordination with the reports of the other task groups. For example, extensive information is contained in the report of Task Group 3 regarding criteria for compatible development of land in areas exposed to high levels of aircraft noise. Unfortunately, no reference or use is made of the information generated by Task Group 3

(Noise Input Characterization), by Task Group 2 (Aircraft/Airport Operations Analysis) or by Task Group 1 (Legal/Institutional Analysis). As in the past the military is apparently attempting to deal with this difficult situation on its own, without assistance from other federal agencies regardless of statutory responsibility to perform such functions. I refer, of course, to the CAA/FAA/DOT which have long possessed virtually exclusive statutory authority to regulate aircraft noise but have failed to do so.

Undoubtedly, military self reliance as reflected in the draft report is conditioned upon the abject failure of the CAA/FAA/DOT to implement any regulations or other measures for the control of aircraft noise and residential developments around airports. Recognizing the implications and severity of the problem, the military has attempted within means at its disposal or, at least apparent to it, to preserve the operability of its airbase facilities and the public investment in them. The Congress should be unmistakably informed that the primary reason aircraft noise problems, both civil and military, have escalated is the deliberate refusal, verging on malfeasance, of the CAA/FAA/DOT to regulate aircraft noise through all means available. The CAA/FAA/DOT have failed even to provide noise exposure data needed by state and local governments for noise compatible land use planning and development. It is the concern of many public interest organizations, including N.O.I.S.E., that there is a lack of objectivity on the part of the EPA and perhaps the DOD in recognizing and so reporting to Congress, the historic failure of the FAA to regulate for aircraft noise control and the consequent need to reorganize federal agency authority.

In direct contradiction to the military position favoring the provision of cummulative noise exposure date for land use planning is the FAA refusal to make public such information because, as is so often stated by airline and airport spokesmen, its publication will result in legal liability. The result of the FAA/ATA/AOCI position of witholding noise exposure data has been the continued encroachment of incompatible development in the vicinity of civil and military airports. In December 1971, the FAA Administrator reportedly instructed subordinates not to provide noise exposure data in terms of NEF units. Subsequently, the FAA developed and currently subscribes to the "aircraft sound descriptive system" (ASDS), a totally unscientific and useless measure. The FAA continues to insist on the use of ASDS over the written objections of HUD, NASA, EPA and even DOT. Documentation of these objections should be included in the EPA report.

Given the magnitude and nature of the problem, it is incomprehensible that there is yet no comprehensive systematic federal program to which the military and others may turn for alleviating the problem. Although Congress and the President have each in the past mandated so-called "interagency" cooperative programs, the FAA/DOT have successfully subverted their responsibility not only toward people living in the vicinity of airports but to the long term interest of aviation as well.

Since 1952, official reports, without exception, recognized the dimensions of the aircraft noise problem together with the measures needed to resolve it. A "systems" approach was always specified. Yet, now in 1973, there is no such comprehensive plan or strategy advanced by the FAA/DOT nor is one under active consideration publicly.

With the passage of the Noise Control Act of 1972 (P. L. 92-574), Congress directed the EPA to look into aircraft noise problems and report its findings to Congress. On its own volition, EPA determined the wisdom of including "military aspects" in its report. In its broadest context, the draft report of Task Group 6 represents the traditional well intentioned effort on the part of the military to influence, on an ad hoc basis, state and local governments to adopt rational controls on urban development in areas of high aircraft noise exposure. Inspite of its lack of success, the military deserves public approval for its efforts to protect the environment of air facility neighbors.

An example of great merit for dealing with the aircraft noise problem was provided to Task Group 6 in the memorandum of Captain R. [illegible]. Anderson, U.S.N., dated 3 May 1973. Captain Anderson's recommendations for "uniform noise exposure criteria," "uniform compatible uses of land" and "a set of recognized legal machinery which will force the zoning issue etc, are remarkably consistant with basic strategy recommendations contained in the draft reports of Task Groups 1, 2, 3, and 5. As a participant, I can attest that these recommendations were arrived at independently. In essence, it appears Captain Anderson is recommending airport certification for noise, the only logical mechanism for comprehensively relating control of noise at the source to complementary controls on land use. I suggest that Captain Anderson's memorandum be made part of Appendix B of the Task Group 6 chapter of the EPA report to the Congress.

The recommendations contained on pp. VI -2-8, 9 are strongly endorsed. The following additional recommendations are offered for both EPA and DOD endorsement and for inclusion in the EPA report to Congress:

1. Reorganize Existing Federal Agency Responsibility for Aircraft Noise Control.

   Twenty one year's experience attests to the lack of competence or even a modicum of incentive on the part of the CAA/FAA/DOT to deal effectively with the aircraft noise problem.

   Recommendations. Task Group 6 recommend the following legislative changes:

   a) Establish EPA as lead agency responsible for aircraft noise standards based on public health and welfare criteria.

   b) Establish NASA as lead agency for development and certification of aircraft noise and exhaust emmission controls according to economic reasonableness, technical practicality and safety considerations.

   c) Relegate FAA to role of enforcement of regulations proposed to it by EPA for airport certification and by NASA for hardware and operational technology.

d) Authorize HUD to establish mandatory national guidelines for urban development in airport communities.

2. Military Airbase Noise Exposure Analysis and Implementation Plan.

The following assumptions are given:

a) Citizens living in the vicinity of military airbases are entitled to environmental protection equal to that of residents near civil airports.

b) Together with civil airport operators the military is obligated to limit noise nuisance to a determinable level and to inform affected communities thereof.

c) The Congress does/will not desire to assume unlimited federal liability for noise damages at military air bases after requisite public health and welfare standards are established for civil airports and civil aircraft noise levels have been reduced by application of acoustic technology.

d) The Congress does not desire the continued expenditure of federal funds which encourage noise incompatible urban development in the environs of military and civil airports.

e) Mandatory regulations (i.e., decertification of air service), economic incentives (i.e., planning and development grants and/or low interest loans to assist effecting land use controls and change) and economic sanctions (i.e., witholding of federal funds to states and localities) are all necessary to obtain controls on urban development around airports.

f) A comprehensive compliance/implementation plan based on uniform national standards and guidelines is needed at all airports whether civil or military if they are ever to be protected brom encroachment by noise incompatible urbanization.

3. EPA/DOD Task Force for Military Aircraft/Airbase Noise Control and Compatible Land Use.

The military aircraft noise situation differs sufficiently from the civil case that a new task force effort similar to that accomplished by EPA under Sec. 7, P. L. 92-574, should immediately be initiated. Unquestionably, both EPA and DOD have adequate authority.

Recommendation. EPA assume lead agency responsibility for task force leadership with express DOD concurrence.

4. National Land Use Policy Act

EPA and DOD recommend to the Congress legislation to amend the recently enacted Land Use Policy and Planning Assistance Act of 1973 (formerly S. 268) to incorporate economic incentives beyond mere planning assistance funds, providing for severe financial sanctions against states and localities for failure to control development to protect the public investment in aviation facilities.

5. Operating Procedures to Reduce Aircraft Noise.

Contrary to the notion often expressed by some aviation operations "experts", the use of flight procedures which result in significant noise reductions does not derogate safety. The conclusions of the attached report of the Boeing Co., "Effects of Aircraft Operation on Community Noise," dated June 1971, authoritatively document the benefits available through operating procedures. While military aircraft are different, procedural changes are relevant.

Recommendation. EPA recommend to DOD the analysis and implemantation of noise control procedures with acoustic measurements, for eash aircraft type operated in significant numbers. Preferential runway utilization and other airport aids also have applicability on a service wide basis.

Reproduced from best available copy.

6. Military Assistance in Noise Control Technology Development

Throughout the development of aeronautics in this country military requirements have funded research and development benefiting civil aviation. This application should be restored.

Recommendation. EPA request that Congress authorize up to 10% (ten percent) of cost of certain categories of military powerplant and airframe development be allocated to noise and exhaust emission reduction.

One final recommendation is not for transmittal to the Congress. It relates to the combining of the separate issues of aircraft noise and aviation safety in the draft report. Extensive personal experience in dealing with citizens' complaints and with local officials concerned with aircraft noise has confirmed the undesirability of relating noise abatement to flight safety.

Recommendation. All reference to aircraft accidents actual and potential be omitted from the final report of Task Group 6 and not used again by the DOD in its aircraft noise program.

Thank you for considering these views and for appending them to the report to the Congress.

cc: Mr. John C. Schettino

Attachments:
1. The Boeing Company report "Effects of Aircraft Operation on Community Noise", dated June 1971.
2. "Aircraft Noise as a Continuing National Problem" by Lloyd Hinton from the proceedings of the International Conference on Transportation and the Environment, May 1972.

EFFECTS OF AIRCRAFT OPERATION ON COMMUNITY NOISE

by

M. C. GREGOIRE

and

J. M. STRECKENBACH

THE BOEING COMPANY
COMMERCIAL AIRPLANE GROUP
SEATTLE, WASHINGTON

June 1971

EFFECTS OF AIRCRAFT OPERATION ON COMMUNITY NOISE

M. C. Gregoire and J. M. Streckenbach
The Boeing Company
Commercial Airplane Group
Seattle, Washington

Reproduced from best available copy.

ABSTRACT

Several means of reducing community noise through changes in airplane operations are discussed and specific examples given. The discussion is divided into two general areas of responsibility: regulatory changes affecting traffic in the airport vicinity and operational or procedural changes available to the airlines. The latter category is further divided into those procedures currently optional to the pilot and airline and those that can be made available through airplane system modifications. Flight profiles for specific airplanes at specific airports are included, along with the noise reductions available. System block diagrams and actual flight data are provided when available. It is concluded that significant reductions in community noise can be attained through operating changes, without affecting safety, and at low cost. Recommendations are made for a course of action to define and implement feasible techniques.

INTRODUCTION

Public pressure is increasing daily against the airlines, the airframe and engine manufacturers, and local airport authorities to reduce aircraft-generated noise in airport communities. Three general areas of community noise improvement have been and continue to be studied to solve this ever-increasing problem. The three areas can be summarized as:

1) Reduction of the noise at its source by quieting the engine installations on the aircraft
2) Changes in land utilization in airport communities
3) Changes in operational procedures in the vicinity of airports

The first of these areas has been the subject of extensive investigation by industry and government agencies for several years. Recent enactment of Federal Air Regulations, Part 36, by the Federal Aviation Administration has established noise criteria for the design and certification of new aircraft not previously certificated. Although not the subject of this paper, considerable work now being done in industry and government programs is related to examining means of retrofitting the existing fleet of commercial fanjet transport aircraft to significantly reduce their community noise levels. As would be expected, the magnitude of noise reduction attained is closely related to technical feasibility and to the economics of airplane modification and operation.

To summarize the second area, it will only be stated here that both Federal and local agencies are continuing to study the possibilities of community noise relief through better land utilization. Such studies encompass the subjects of improved planning for new airports, tightened building codes and zoning restrictions, and revised land utilization around existing airports. Obviously, as in the case of retrofitting the current fleet with quieter engine installations, economics is an important and unavoidable consideration in land utilization studies.

The third area, noise-abatement operating procedures, is discussed as the main topic of this paper.

NOISE REDUCTION THROUGH OPERATIONAL CHANGES

A potential for significant relief of the community noise problem at relatively low cost lies in several areas of airplane operation in the vicinity of airports. In 1966, Oscar Bakke of the FAA presented a paper that discussed several aspects of air traffic control and flight procedures as related to reducing community noise.(1) Some of the general areas discussed by Mr. Bakke are covered in this paper, with the added benefit of several years' study and actual flight testing conducted since his paper. Examples are presented for specific aircraft in an attempt to add emphasis to the feasibility of several methods of reducing community noise.

Recommendations of the International Civil Aviation Organization (ICAO) relative to safety considerations in establishing noise abatement operating procedures(2) are recognized as typical constraints in the discussions that follow.

Potential areas of noise reduction through operating procedures fall roughly into two categories: (1) Federal or local air regulations and (2) operating procedures that are or may be made available to the airlines.

Regulatory	Operational
• Holding and maneuver altitudes	• Delayed flap and gear extension
• Optimized traffic patterns	• Two-segment approaches
• Glide slope	• Flap position for landing
• Glide slope intercept altitude	• Takeoff procedures

As will be discussed later, any consideration of these potentials for noise relief must include their relationship to safety, airplane performance constraints, aircraft modification requirements, pilot acceptance, the geography of the specific airport, and the economic aspects of the change.

Regulatory Changes

In general, any action taken to increase the height of aircraft over a community will reduce noise in the community. Many complaints in the past have been based on aircraft flying at low altitude for miles over the community during landing approach. The FAA "keep 'em high" order,(3) released on September 19, 1970, has community noise reduction as one of its purposes. Approach and departure handling of commercial jets at many airports are already reflecting the benefits of this order. Specific quantitative examples of implementation of such procedures will be shown later in this paper.

Holding and Maneuver Altitudes. The holding or maneuver altitudes over suburban areas are shown in figure 1 to have a sizeable effect on noise under the aircraft. The example shown is based on a 727-200 airplane at a landing weight of 150,000 lb. Besides the noise-reduction benefits of increasing the altitude, additional benefits exist in selection of airplane configuration (e.g., flaps and landing gear). As illustrated, in the zero-flap, gear-up configuration, a noise reduction of 9 EPNdB* results from increasing the altitude from 1500 to 3000 ft. Avoiding flap and gear extension until really required, combined with the 1500-ft altitude increase, gives noise reductions of as much as 16 EPNdB.

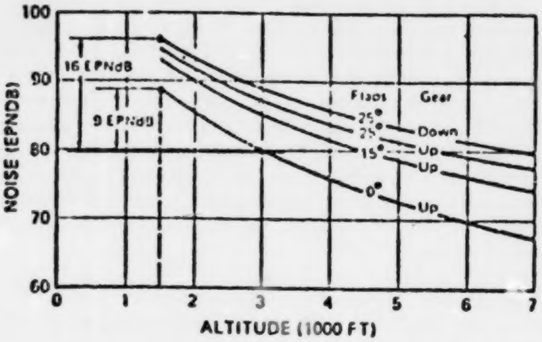


Figure 1. Effect of Holding or Maneuver Altitudes on Noise

It is apparent from this that, in any cases where holding or maneuver altitudes can be raised and clean configurations maintained within constraints established by traffic requirements, definite reductions in community noise can be realized at little or no cost.

Optimized Traffic Patterns. The noise benefits available through optimizing traffic patterns are mainly related to routing of arriving and departing aircraft over nonsensitive areas of the community. This is being done at many aiports now, in some cases at the expense of traffic handling flexibility. Rerouting of traffic in the JFK International Airport area in New York to avoid flying over densely populated areas has severely restricted the traffic handling flexibility of that airport, but there is no questioning the direct benefit of such action to the noise-sensitive public.

Glide Slope. Standard glide slopes at airports throughout the world have been generally established on the basis of safety, pilot acceptance, and airplane performance capabilities. This should not preclude a further look at glide slope changes as a potential area for noise abatement, as long as these same factors are kept in mind. The easiest point of departure for discussing glide slope changes starts with the fact that 3° glide slopes are generally accepted and are standard at many airports today. However, approximately 30% of present glide slopes at major United States airports are as low as 2.5°.

Numerous actual test flights have been conducted by Northwest Airlines(4) on 707, 727, and 747 aircraft at glide slopes on the order of 1/2° above the ILS slope. These flights have demonstrated approach noise reductions of 1 to 5 PNdB, depending on the airplane type and microphone location. The flights have been conducted by visually mismatching the reference airplane symbol and the flight director command bars, so that the airplane followed a path above the ILS glide slope. These flights have demonstrated that raising glide slopes is worthy of consideration as a noise-abatement action.

Analyses conducted by Boeing generally confirm the Northwest Airlines flight data. Figure 2 illustrates the trades between glide slope angle and noise for the 727-200 airplane at various distances from the runway threshold. Noise reductions on the order of 5 to 7 EPNdB are shown for a 1° increase in glide slope. Similar benefits are available with other aircraft.

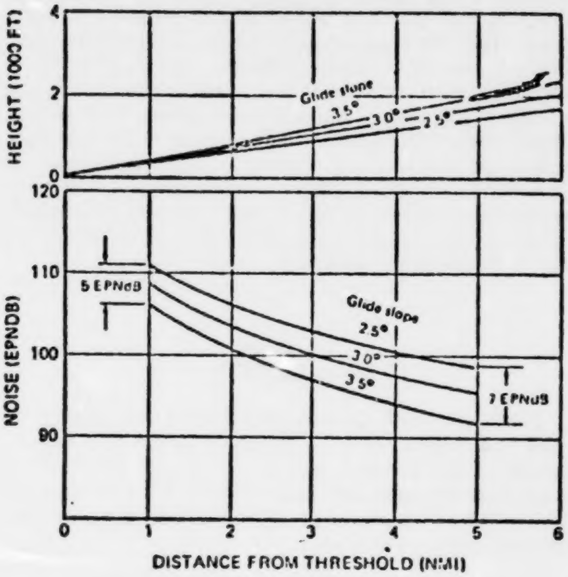


Figure 2. Effect of ILS Glide Slope on Noise

Another way of looking at the noise benefits of higher glide slopes is the change in community area in square miles subjected to a given noise level. Figure 3, again using the 727-200 airplane as an example, shows the area in the community under the approach path subjected to a noise level of 90 EPNdB or higher as a function of glide slope angle. Note that a change from 2.5° to 3.5° glide slope will result in nearly a 70% reduction in the community area subjected to the reference noise level. This can be related to 70% of the population in a residential area.

The foregoing discussion has related to small changes in glide slope that we believe could be implemented at relatively low cost at all airports without degrading safety.** They represent changes that appear to be well within the region of acceptance by most airline pilots flying current-generation jet transport aircraft. Precedence has been established and demonstrated by the 3.22° ILS glide slope at San Diego International and by hundreds of jet landings per week for several years on the 3.5° ILS glide slope on runway 27L at Berlin's Tempelhof Airport. To our knowledge, no landing accidents have occurred at Tempelhof that could be attributed to the glide slope angle. Pilot acceptance of 3.5° glide slopes, without need for changes in approach techniques, has been indicated by the Air Line Pilots' Association.(5)

---

*The EPNdB noise unit incorporates adjustments for the subjective effects of aircraft noise on humans, including corrections for tone and duration, as defined in Federal Air Regulations, Part 36, dated November 3, 1969.

**For Category II landings, FAA Advisory Circular 120-29, dated September 25, 1970, specifies a 3° maximum glide slope. Reconsideration of this limitation may be justified in the future in light of community noise benefits of increased glide slope angles.

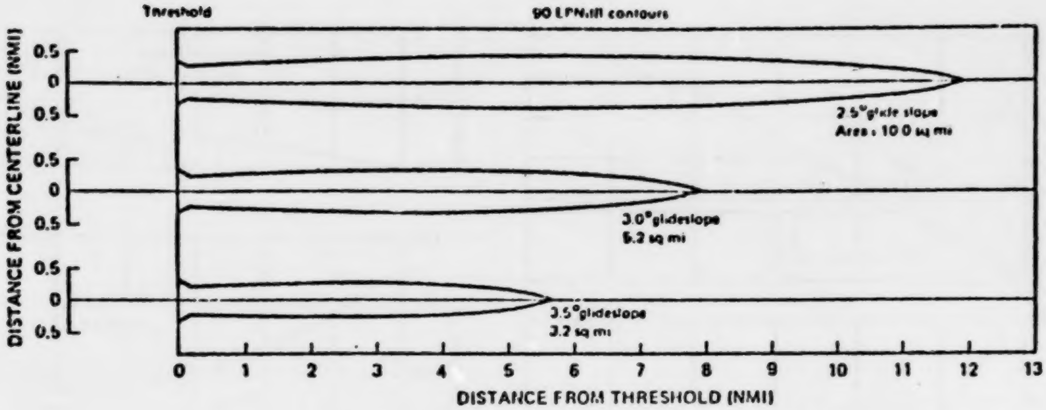


Figure 3. Noise Footprint Comparisons of Various Glide Slope Angles

Future development of the currently planned microwave scanning-beam guidance system will provide additional noise-reduction capability in the areas of traffic patterns and glide slopes. Such a system will provide pilots with programmed, curved, precision flightpath guidance data in both elevation and azimuth, permitting steeper descents and avoidance of residential communities.

Glide Slope Intercept Altitude. The effect on community noise of glide slope horizontal intercept altitude is illustrated in figure 4. Here again, using the 727-200 in a simplified example, the airplane is shown approaching the ILS glide slope at altitudes of 1500 and 3000 ft. In both approaches, the same flap and gear positions are used. The 7 EPNdB lower community noise for the airplane at 3000 ft is due only to the altitude difference. This simple case illustrates the type of noise benefits currently being attained through implementation of the FAA "keep 'em high" order discussed previously.

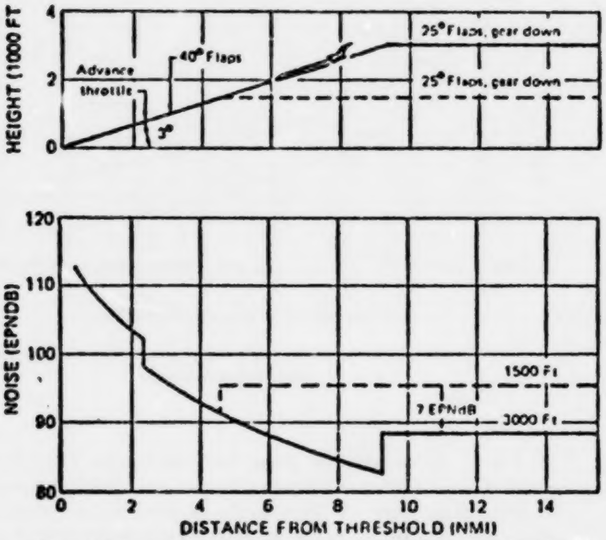


Figure 4. Effect of Horizontal Intercept Altitude on Community Noise

Now let us take a situation in which the noise abatement principles of the FAA order have been implemented at a major airport. Figure 5 shows two arrival profiles into Love Field, Dallas, Texas, using runway 13L. The Bridgeport Two arrival was in use prior to August 20, 1970. Since then the Holly One arrival has been instituted for noise control. We have constructed the illustration using a 727-200 airplane, following our understanding of typical Love Field approaches by these two arrival routes, including vectors to final approach course. Although the ground tracks for the two approaches are different, their respective altitudes above the community serve to compare the differences in noise levels under the flightpath attributed to low versus high profiles. Similar noise benefits can be shown for any jet transport approaching Love Field on these profiles.

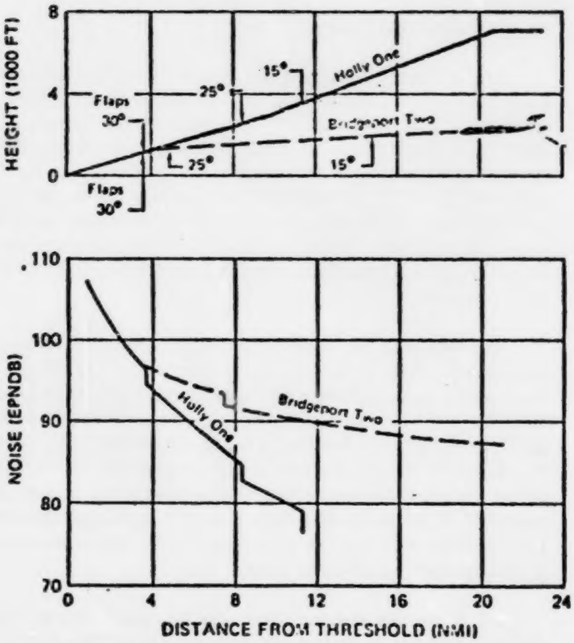


Figure 5. Effect of Increased Altitude on Noise in Dallas-Love Field Arrival Routes

Another example of what higher intercept altitudes will do for community noise is shown in figure 6. Here a 707-320B airplane is shown at various intercept altitudes approaching the 2.75° ILS glide slope on JFK runway 22L in New York City. Again, as in the Dallas illustration, it is seen that implementation of higher altitudes over the community provides significant noise relief at minimal cost.

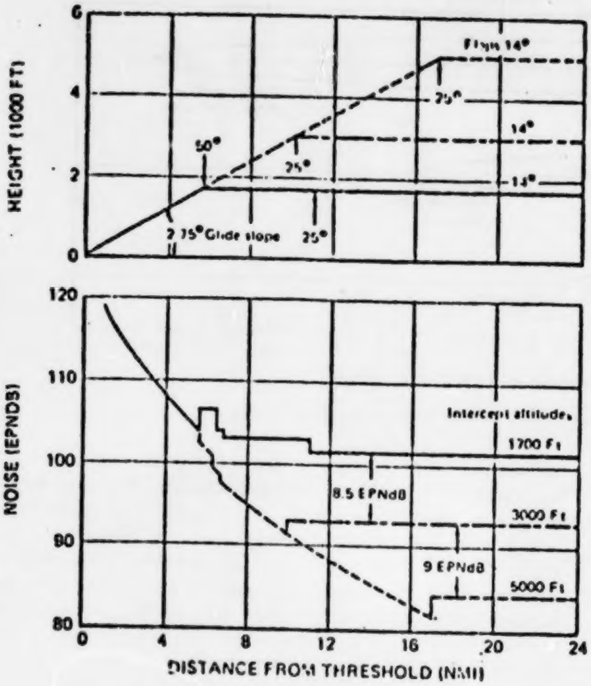


Figure 6. Effect of Increased Altitude on Noise in New York–JFK Arrival Routes

Airline Operational Changes

The foregoing discussion has shown some of the community noise benefits attainable through changes in Federal and local regulations related to holding altitudes, traffic patterns, glide slopes, and glide slope intercept altitudes. Now let us look at some of the procedural options available (or that can possibly be made available) to the airlines for reducing community noise, separate from regulatory changes. In some cases, as will be discussed, equipment modification may be necessary or desirable to permit certain procedures without adverse effects on safety or pilot acceptance.

Delayed Flap and Gear Extension. Noise in the community can be reduced by delaying landing flap and gear extension until close to the runway threshold. Figure 7 compares two cases for a 727-200 airplane. Note that, for several miles over the community, the delayed flap and gear extension reduces the noise on the order of 7 EPNdB. This option is available to the airlines without airplane modification. The minimum distance from the threshold at which landing flaps and gear are extended is subject to pilot discretion but can be considerably closer in than is often practiced, with no effect on safety.

Whatever the distance from the threshold may be for the above technique, using current airplane systems, the distance can be reduced even further if sufficient systems automation is provided to avoid increasing pilot workload or degrading safety. To gain the maximum noise benefit from delayed flap and gear extension, the procedure must be capable of maintaining reduced thrust levels until the airplane is beyond the noise-sensitive area, e.g., probably less than 1 nmi from the threshold.

Figure 8 shows that, using the same profiles as in figure 7 but delaying extension of landing flaps until closer in and with the aid of systems automation, the noise reduction under the flightpath continues to within less than 1 nmi from the runway threshold.

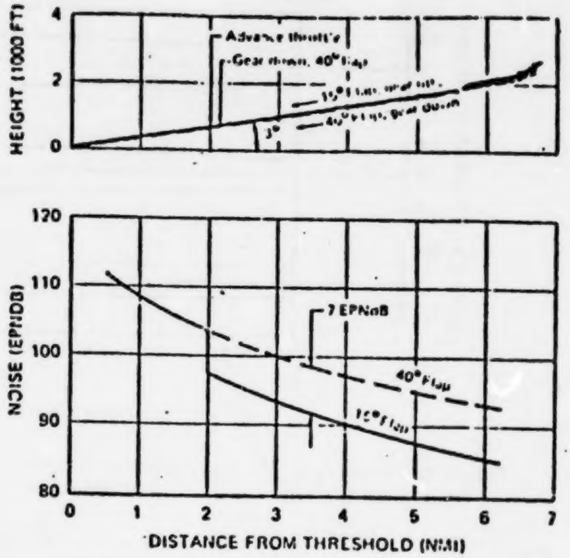


Figure 7. Noise Reduction by Delayed Flap and Gear Extension

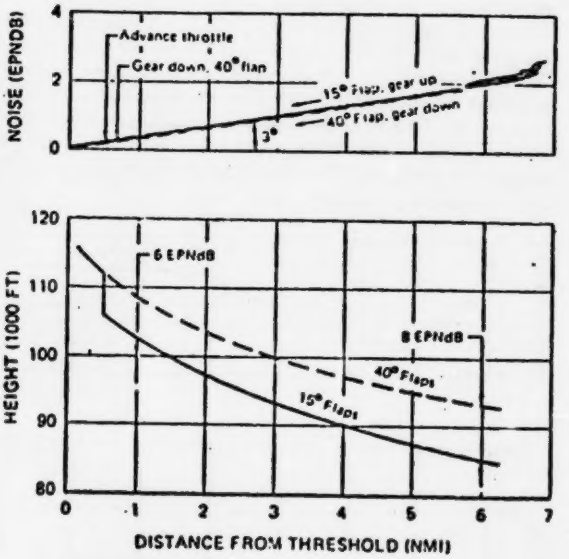


Figure 8. Noise Reduction by Delayed Flap and Gear Extension—Automated Approach

Figure 9 compares the noise levels of figures 7 and 8 by means of noise footprint contours. The contour for flying down the glide slope with 40° flaps and gear down has an enclosed community area of 5.2 sq mi. By delaying extension of flaps and gear, this area is seen to reduce by 64% or 72%, depending on whether the profiles of figures 7 or 8 are used.

As previously stated, delaying flap and gear extension to as late as shown in figure 8 requires sufficient system modifications to avoid increasing pilot workload or degrading safety. The Boeing Company has improvised a closed-loop system that holds to these guidelines. A closed-loop system is one that has a programmed schedule but has the inherent logic and feedback to correct for deviations from the schedule. The system has been

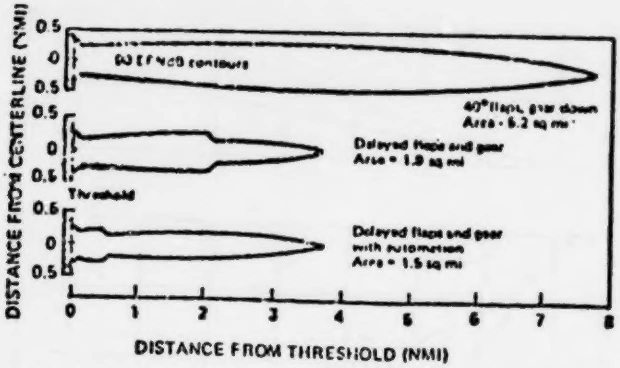


Figure 9. Noise Footprint Comparisons of Delayed Flap and Gear Approaches

operated in a flight simulator and flight tested on the company-owned 727-200. The components of the system, shown in the block diagram of figure 10, consist of:

1) Autothrottles
2) Electrohydraulic flow valves
3) Flap position transmitters
4) Control panel
5) Autoflap coupler
6) Autothrottle computer
7) Visual landing aid sight and computer
8) Central air data computer

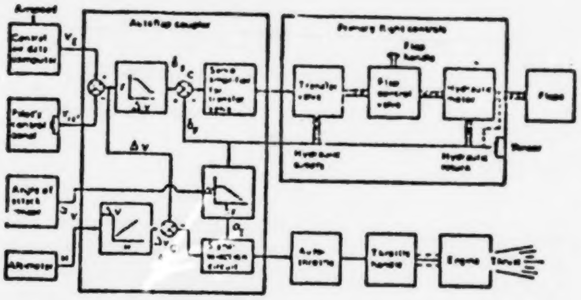

Airspeed
Central air data computer
V_c
Pilot's control panel
V_{ref}
Angle of attack vane
Altimeter
Autoflap coupler
ΔV
δ_{f_c}
δ_f
α_f
Servo amplifier for transfer valve
Signal selection circuit
Primary flight controls
Flap handle
Transfer valve
Flap control valve
Hydraulic motor
Flaps
Hydraulic supply
Hydraulic return
Sensor
Autothrottle
Throttle handle
Engine
Thrust

Figure 10. Autoflap Schematic–Approach Mode

The procedure that has been the most successful follows:

1) The pilot establishes approach configuration–flaps 15°, gear down, altitude above 1500 ft, and airspeed equal to V_{ref} + 55 kn.

2) Prior to intercepting the glide slope, the autoflap system is armed by selecting the LAND mode on the control panel.

3) The flap handle is then moved to the desired final flap setting, and the corresponding final approach speed is set on the speed index (bug).

4) The glide slope is captured and final descent initiated.

5) As the airplane passes through approximately 1,200 ft above the runway, the system is triggered.

6) The altitude change demands a speed reduction that is accomplished by retarding the throttle.

7) The flaps are controlled by airspeed and extend as speed is reduced.

8) When flaps reach the final desired position and the airspeed is within 5 kn of the final speed set on the bug, the throttles advance automatically to arrest the deceleration. At this point, the airplane is about 200 ft above the runway. The airspeed then stabilizes and is constant until landing flare is initiated.

Throughout the autoflap approach, because of speed programming, the airplane's body attitude remains constant. The sample flight profile, figure 11, demonstrates the automatic flap management experienced with the Boeing flight test airplane. This particular profile was flown without use of the autopilot by manually following the instrument cues.

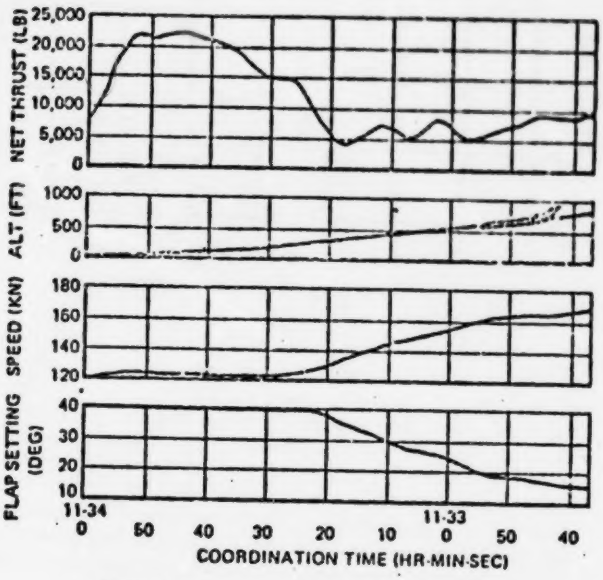


Figure 11. Autoflap Approach–727-200 Flight Test

Note that the low thrust level for approach flaps is held during the flap extending period until the 350-ft altitude point. The speed and altitude are bled off smoothly as the flaps extend. The maximum throttle movement during flap extension was 1.3°. (System refinements, such as automatic trimming devices and autopilot, are being investigated to reduce this amount even further.) At the point where flaps are full down and speed is V_{ref} + 5 kn, thrust required to hold the glide slope (about 21,000 lb) is applied automatically. The remainder of the approach is flown normally.

In view of the substantial noise reduction shown in figure 8, this concept merits further development.

Two-Segment Approaches. Significant reductions in community noise result from intercepting the final glide slope from a steep descent, say 6°, as compared to flying the glide slope from many miles out. Figure 12 compares the approach profiles and corresponding community noise levels of a 727-200 airplane following a normal (3°) glide slope, and the same airplane performing a two-segment approach with steep descent to the glide slope. Flap and gear configurations are the same in both profiles, so the noise benefits shown are related only to differences in airplane descent angles. Note that the transition is made at 1000 ft altitude (about 3 nmi from the threshold[†]). This will give the pilot adequate time to stabilize on the glide slope without revisions to the current airplane systems.

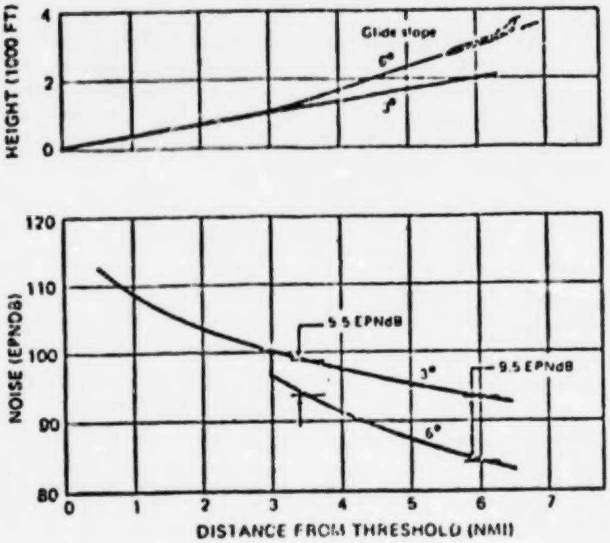


Figure 12. Two-Segment Approach

By providing system automation to permit transition from the steep descent segment to the glide slope closer to the airport, the noise benefit to the community improves, as shown in figure 13. This illustration uses the same airplane configurations as shown in figure 12, but transition from 6° to 3° slopes is initiated at 250 ft altitude, less than a mile from the threshold. Figure 13 shows noise reductions on the order of 5 to 13 EPNdB at distances of 1 to 6 nmi from the runway threshold. These are significant reductions, certainly of a magnitude readily discernable to residents living under the approach flightpath of the airplane.

Figure 14 compares the noise footprint contours of the above two-segment approaches with a normal 3° glide slope. Note the significant noise benefit of a 73% area reduction in the contour for the close-in transition of figure 13.

Regarding the feasibility of operating on such a profile, let us discuss means of accomplishing this steep descent with close-in transition within limits of safety and pilot acceptance.

Simulator development and flight testing of the Boeing model 367-80 (707/KC-135 prototype), conducted in 1968 under the NASA/Boeing investigation of noise abatement landing approaches(7)(8) demonstrated that two-segment approaches with close-in transition are feasible. This investigation was flown at Oakland International Airport using the existing glide slope of 2.65° and steep descent of 6° with intercept altitudes of 250 and 400 ft. The research airplane was equipped with improvements over current jet transports, including a modified flight director, an autothrottle, and stability augmentation that improved longitudinal and lateral directional handling qualities. The test profiles were flown by one airline pilot, six FAA pilots, and four NASA pilots under simulated instrument conditions.

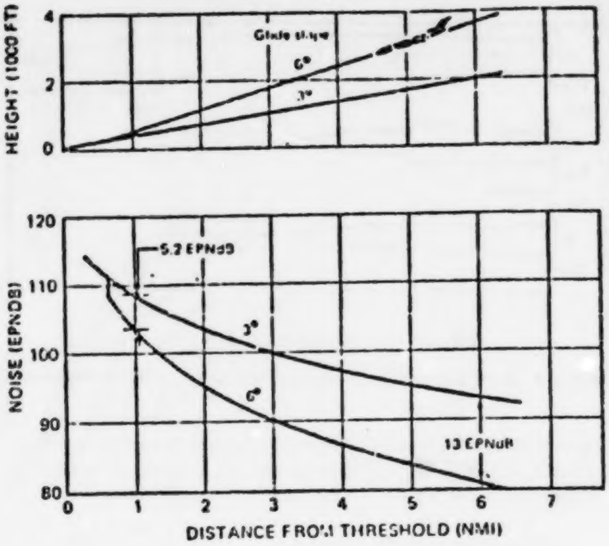


Figure 13. Two Segment Approach with Close-In Transition

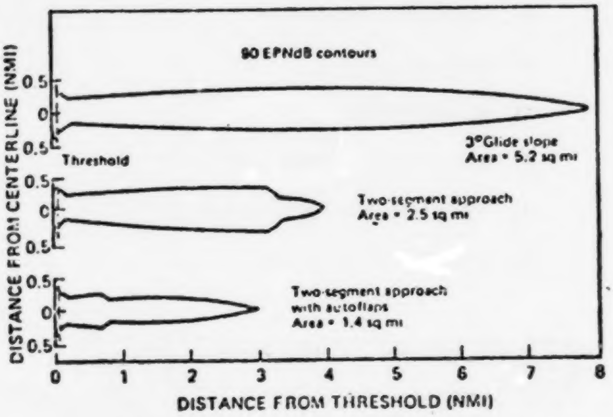


Figure 14. Noise Footprint Comparisons of Two-Segment Approaches

The conclusions reached were that two-segment profiles could be flown in a modified jet transport with the same precision as a conventional instrument approach without a significant increase in pilot workload and with a significant reduction in community noise.

Adoption of such procedures for airline use would require further development and tests to establish the requirements and operational limitations of two-segment approaches in an environment more representative of airline operations and under conditions of combined adverse weather and airplane equipment or guidance failures.

[†] Bolt, Beranek, and Newman, Inc.(6) considered two-segment approaches in their 1970 study, with transition from 6° to 3° slopes at 3 nmi from the threshold.

Flap Setting Effects on Approach Noise. Another source of community noise reduction is the pilot option of flap position selection during approach and landing. We have probably all experienced actual flights in which landing flaps were dragged for many miles over a residential community prior to intercepting the glidepath. Figure 15 compares two approaches for the 727-200 in the same profile but at different flap positions. It shows that, at the same altitude, there is a noise difference of from 3 to 7.6 EPNdB between these two cases. As a comparison, a 707-320B or C landing at 25° flaps is about 3 to 4 EPNdB quieter at 1 nmi from the threshold than when using the normal 50° flaps. Modification to permit 25° landing flaps on these airplanes has been determined feasible. The 5-kn higher landing speed for 25° flaps would result in about a 340-ft increase in landing field length.

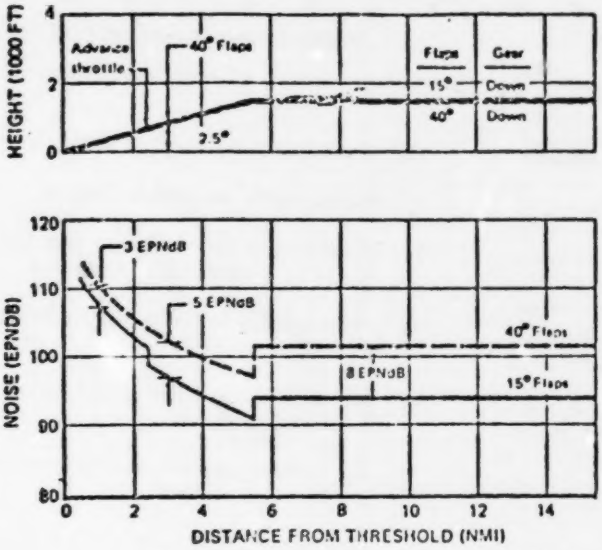


Figure 15. Effect of Flap Setting on Approach Noise

If we now combine the above flap options with the effects of intercept altitude and moderate change in glide slope discussed earlier, we have the picture shown in figure 16, showing significantly greater noise reductions than in figure 15.

Both of these profiles are within the limits of current airplane capability and operating procedures and we believe would not require any special equipment or techniques.

Now let us include the capabilities available through the approach system automation discussed in connection with delayed flap and gear extension and with steep, two-segment descents. Modifying the figure 16 profiles to include these capabilities as well as a 3.5° glide slope, we arrive at figure 17, which represents the total potential noise reduction available through adoption of approach noise abatement regulations and procedures and development of appropriate equipment.

Noise Abatement Takeoff Procedures. Many takeoff profile choices can be, and have been, investigated for reduction of community noise. The most obvious, involving only the choice between takeoff power all the way versus power cutback at some acceptable altitude, is recognized as a means of reducing noise in the close-in community.

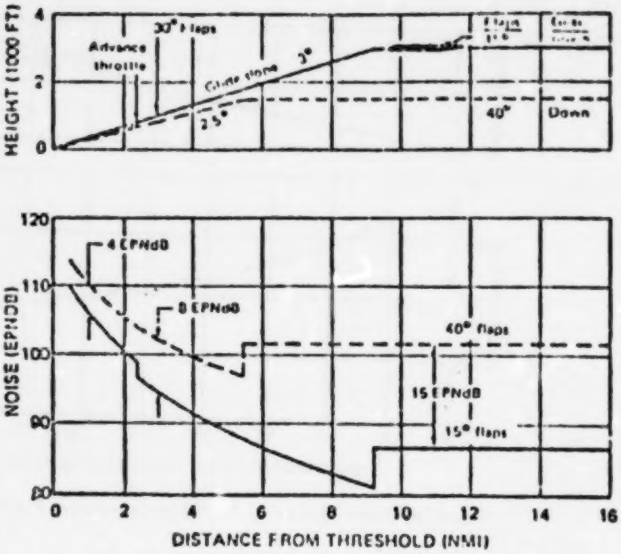


Figure 16. Combined Effects of Flaps, Altitude, and Glide Slope on Approach Noise

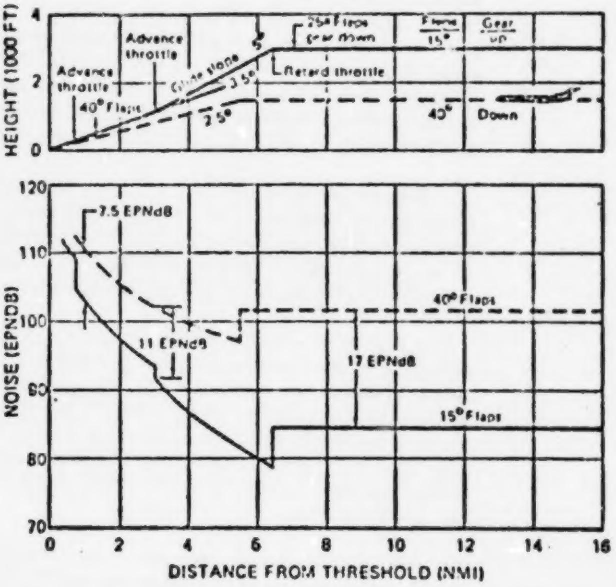


Figure 17. Approach Noise Reduction Potential Through Combination of New Techniques

Mr. Bakke[1] compared several takeoff procedures proposed by the FAA, by the Air Line Pilots' Association, and standard operating practices of five major airlines. Some of these procedures, monitored in actual day-to-day operations at JFK International Airport, demonstrated noise reductions over the community on the order of 4 to 7.5 PNdB. Such reductions are to be encouraged. Studies at Boeing have generally confirmed these findings. Noise-abatement takeoff procedures can be performed effectively with virtually all present-day jet transport aircraft without modification of the aircraft, with no effect on safety, and with little effect on pilot workload. Beyond this, techniques involving some automation and capable of even greater noise benefits are believed within easy reach. Discussions of specific examples of both types of procedures follow.

Again, using the 727-200 airplane as an example, figure 18 compares two takeoff profiles, both employing power cutback at 3.5 nmi from brake release but using different flaps. Power cutback in both cases is to the level that would maintain level

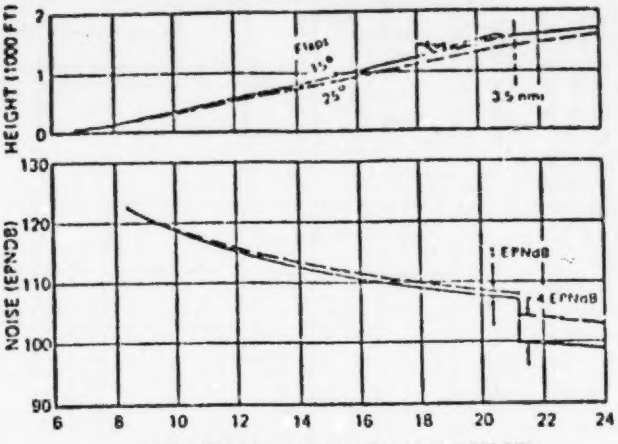


Figure 18. Comparison of Two Takeoff Profiles—Manual Flap Retraction

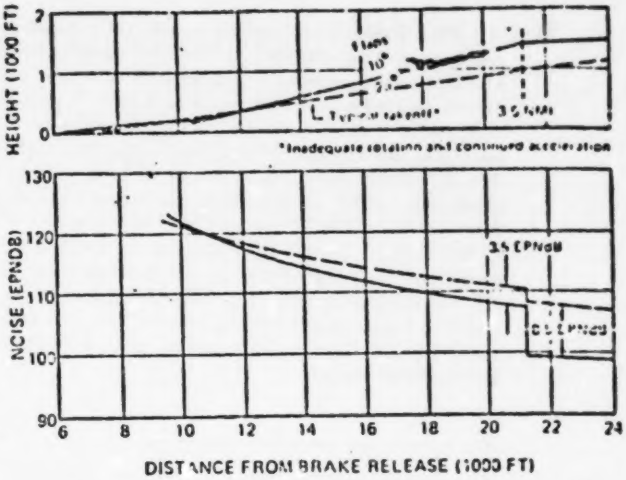


Figure 19. Comparison of Two Takeoff Profiles—Automated Flap Retraction

flight with one engine inoperative. Both airplanes take off with 25° flaps. One maintains this flap setting throughout climbout, whereas the other, after accelerating to V_2 + 10 kn, retracts flaps to 15°. Note that the 15° climbout permits a steeper climb gradient (lower noise at takeoff power) and cutback to lower thrust (one-engine-out level flight thrust for 15° instead of 25°), resulting in lower noise after cutback due to both greater altitude and lower thrust. In the case illustrated, the noise reductions are 1 EPNdB and 4 EPNdB before and after cutback, respectively.

This procedure is optional to pilots, requires no airplane modifications, and is similar to operations being used at the present time by certain airlines. Comparable noise reductions were experienced by NASA during 1968 noise abatement takeoffs$^{(9)}$ of the Ames CV-990 airplane at Wallops Station.

An improvement in the noise picture of figure 18 is attainable by incorporating an automated flap system, permitting speed-controlled programming of flaps during climbout. Figure 19 illustrates such a procedure, in which, in one case, the flaps are programmed to 10° after a 25° takeoff, and in the other case, the flaps are 25° all the way. Figure 20 shows a reduction of 50% in the land area enclosed by the 90 EPNdB footprint contour for the autoflap profile.

The additional noise benefit of this procedure seems to justify further investigation of means by which it can be accepted as routine. The closed-loop system mentioned earlier, but in a takeoff mode, has been simulator tested and flight tested by Boeing. The system is shown in the block diagram, figure 21, and consists of a simplification of the approach mode.

The takeoff procedure is simple, utilizing the following:

1) Pilot selects the takeoff flap position.

2) He then arms the autoflap system by selecting the TAKEOFF mode on the control panel.

3) The flap handle is moved to the position to which the flaps will be retracted.

4) The flaps do not move until an electrohydraulic transfer valve is opened.

5) The transfer valve will not open until the following conditions are satisfied.

   a) Airspeed must exceed V_2 + 10 kn for the takeoff flaps.

   b) Landing gear must be up and doors closed.

6) When the above conditions are met, the flaps retract at the normal rate to the position selected previously

7) When this position is reached, the airplane establishes best climb profile.

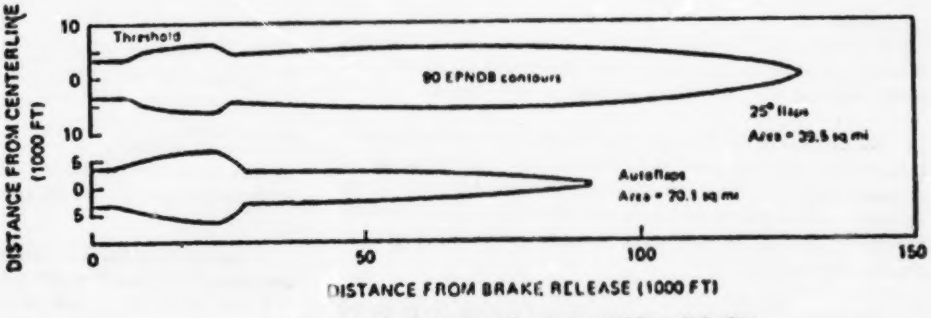


Figure 20. Noise Footprint Comparisons of Takeoff Profiles

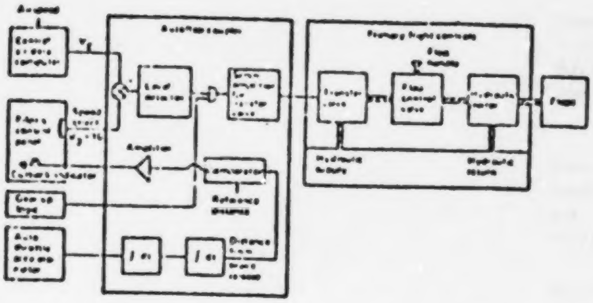


Figure 21. Autoflap Schematic–Takeoff Mode

The system also has the capability of sensing horizontal distance. This information is obtained from the autothrottle accelerometer, which uses double integration to compute the horizontal distance. The computed distance then is compared to a reference distance, and, if exceeded, a light will be illuminated in the cockpit to alert the pilot to initiate noise-abatement thrust cutback procedure.

CONCLUSIONS

On the basis of the foregoing discussion and on the results of testing conducted by NASA, the FAA, the aircraft industry, and the airlines, the following general conclusions are drawn:

1) Significant reductions in community noise can be attained through early adoption of readily available regulatory and procedural operations changes in the vicinity of airports. Such changes can be made at little cost, would require no particular increase in pilot skill or pilot workload, and are not considered to have any effect on safety.

2) Further noise reduction benefits are available through certain additional operating procedures requiring development of techniques and equipment modifications to avoid increasing pilot workload.

These conclusions were generally supported in an April 1971 paper,(5) presented by the Air Line Pilots' Association at the FAA National Aviation System Planning Review Conference.

RECOMMENDATIONS

Because of the potential community noise benefits to be gained through noise abatement operating procedures, a two-phase positive course of action to define and implement feasible techniques is recommended. We suggest that such a program be conducted under FAA sponsorship as an industry cooperative effort, with AIA, ATA, and ALPA working together as a team.

Phase I would entail early implementation of regulatory and operational procedures that can be accomplished at little cost and with little or no equipment modification. Typically, they include:

1) Establishing minimum holding pattern and maneuver altitudes of 3000 ft or higher over the terrain

2) Routing traffic over low population densities to the extent feasible

3) Raising all glide slopes to a minimum of 3°, with 3.5° being given serious consideration

4) Establishing minimum glide slope horizontal intercept altitudes of 3000 ft or higher over the terrain

5) Delaying extension of landing flaps and gear as long as practical

6) Using reduced landing flap settings whenever operating conditions permit (at the expense of some increase in landing speeds and landing field lengths)

7) Using segmented takeoff profiles adaptable to each airplane type, specifics of such profiles to be worked out cooperatively by the airlines, the manufacturers, and the FAA

Phase II would include development of additional noise abatement procedures, discussed in this paper, requiring airplane and/or ground equipment modification to preclude degrading safety or increasing pilot workload. The program should consider all U.S. subsonic turbojet-powered commercial transport aircraft as candidates.[††] Participating AIA companies would develop techniques and related equipment modifications for their respective models and flight test the procedures using company, FAA, and airline/ALPA pilots. It would be desirable to standardize procedures, to the extent permitted by individual airplane characteristics, to simplify adoption by the airlines.

Firm technical data would be derived to form a basis for maximum exploitation of the noise-abatement benefits of regulatory and operational changes, including appropriate ground and airborne systems modifications. The program should aim toward ensuring adequate safety; attaining worthwhile noise reduction; eliminating those procedures determined not feasible or worthwhile; and gaining FAA, airline, and pilot acceptance.

It is further recommended that applicable air regulations, such as FAR, Part 36, be modified such that encouragement and incentive is given to noise abatement through operating procedures. This should be an inherent part of the overall effort to reduce community annoyance.

REFERENCES

1. Oscar Bakke, "Air Traffic Control and Flight Procedures," paper included in a report of the Jet Aircraft Noise Panel, *Alleviation of Jet Aircraft Noise Near Airports*, Office of Science and Technology, Executive Office of the President, March 1966.

2. ICAO letter AN 1/54.6-70/32, app. A, annex 16, atch. C, "Guidance Material Relating to Safety Considerations in the Establishment of Aircraft Noise Abatement Operating Procedures," March 19, 1970.

3. *Arrival and Departure Handling of High-Performance Airplanes*, FAA order 7110.22, September 19, 1970.

4. William S. Hieronymus, "New Landing Method Aimed at Reduction in Approach Noise," *Aviation Week*, March 1, 1971, pp. 46 and 47.

[††] The program should include the results of the FAA-sponsored measurement program currently being conducted by Hydrospace Research Corporation.(10) Four different airplanes are being subjected to noise measurements while flying a variety of noise-abatement approach and takeoff profiles.

5. Captain Robert N. Rockwell (Chairman, Noise Abatement Committee, Air Lines Pilots' Association), "Airport Noise and Aircraft Operations," paper presented at the FAA National Aviation System Planning Review Conference, Washington, D.C., April 29, 1971.

6. D. E. Bishop and R. D. Horonjeff, *Noise Exposure Forecast Contours for Aircraft Noise Tradeoff Studies at Three Major Airports,* Final Report FAA-NO-70-7, Contract FA 68WA-1900, Bolt, Beranek, and Newman, Inc., July 1970.

7. Clarence C. Flora, Gerhard K. L. Kriechbaum, and Wayne Willich, *A Flight Investigation of Systems Developed for Reducing Pilot Workload and Improving Tracking Accuracy During Noise-Abatement Landing Approaches,* NASA Final Report CR-1427, Contract NAS 2-4200, The Boeing Company, October 1969.

8. Hervey C. Quigley, C. Thomas Snyder, Emmett B. Fry, Leo J. Power, and Robert C. Innis of Ames Research Center; and W. Latham Copeland, Langley Research Center, *Flight and Simulation Investigation of Methods for Implementing Noise-Abatement Landing Approaches,* NASA Technical Note TN-D-5781, May 1970.

9. H. Rodney Peery and Heintz Erzberger, *Noise Measurement Evaluation of Takeoff and Approach Profiles Optimized for Noise Abatement,* NASA Technical Note TN D-6246, March 1971.

10. *Operational Procedures Noise Reduction Program,* FAA contract awarded to Hydrospace Research Corporation. Program procured under FAA RFP WASR-1-0236, November 16, 1970. Scheduled for completion (final report draft) on July 1, 1971.

International Conference on Transportation and the Environment

Part I

Cosponsoring organizations:

Society of Automotive Engineers, Inc.
Environmental Protection Agency
U. S. Department of Transportation

Proceedings published by:
SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
Two Pennsylvania Plaza, New York, New York 10001

Aircraft Noise as a Continuing National Problem

Lloyd Hinton
Metropolitan Aircraft Sound Abatement Council Minneapolis-St. Paul

THIS PAPER IS INTENDED to present the views of noise impacted airport community residents who, while seriously annoyed, in the majority are moderate in their complaint and deserve relief. The assignment was to "discuss the problem of noise created by airports as seen from the citizen's point of view."(1)*

While airport community residents may prefer that this paper take a more rancorous approach to describe their opinion of aircraft noise, experience has shown that a more objective approach is required. It should be obvious even to industry attorneys that the problem cannot be assessed on the basis of the number of complaint calls nor the amount of damages paid as a result of legal actions. It must be assumed that all desire the end of the aircraft noise problem. Admittedly, there are different reasons and indeed differing views of what constitutes the problem i.e., exposure to aircraft noise per se or exposure to aircraft noise complaints and law suits.

It is not intended here that the causes of the aircraft noise problem be analyzed, rather that viable recommendations for short and long term improvements be provided for discussion and hopefully, early implementation. Because the SAE is a professional society of technical people, it is not usual that papers prepared under its auspices deal primarily as does this one with social/political rather than technical issues. However, a small part of the technical information which is available is referenced to sustain the argument that feasible means for significantly alleviating aircraft noise have long been available if only responsible governmental officials had considered the problem of sufficient importance.

---

*Numbers in parentheses designate References at end of paper.

ABSTRACT

The history of the aircraft noise problem is presented using many references to particularly important studies. Emphasis is placed upon the similarity of expert opinions during twenty years of research for measures needed to resolve the problem. While objectivity is sought -- the common denominator of the aircraft noise issue is controversy -- the author is representing the views of noise impacted airport community residents who cannot comprehend the lack of progress in aircraft noise abatement. This lack of progress has persisted in spite of general agreement on measures needed and is the basis of a call for the reallocation of authority among federal agencies having responsibility both for the regulation of aviation and for the planning and development of urban areas -- including airports -- with environmental protection as basic criterion.

EARLY RECOGNITION OF AIRCRAFT NOISE PROBLEM

In February, 1952, President Truman appointed the President's Airport Commission with General James H. Doolittle as Chairman and Mr. Charles F. Horne, Civil Aeronautics Administration Administrator, and Dr. Jerome C. Hunsaker, Head, Department of Aeronautical Engineering, Massachusetts Institute of Technology, as members.

In his directive of appointment, President Truman said in part:

> "In view of these developments I feel that the nation's policy of airport location and use should be restudied. We need a study that is both objective and realistic. That is what I want your commission to do. In undertaking this survey several major considerations should be kept in mind. On the one hand, provision must be made for the safety, welfare and peace of mind of the people living in close proximity to airports. on the other hand, recognition must be given both to the requirements of national defense and to the importance of a progressive and efficient aviation industry in our national economy."

Characteristic of President Truman, he concluded his charge as follows:

> "Because of the urgency of the problem, I hope you will be able to give me your final recommendations within ninety days.....Arrangements will be made to meet the expenses of your commission out of the Emergency Fund for the President."

In its letter of transmittal of "The Report of the President's Airport Commission,"(2) dated May 16, 19~~7~~52, the Commission stated:

> "In addition, we have obtained the views of civic associations representing people who live in the vicinity of airports but are not otherwise related to the aviation industry. Some of these groups were outspoken in their desire to be relieved entirely of the nuisance and exposure to potential hazard resulting from aircraft operations in their vicinity. The majority were more moderate in their views. Recognizing that aeronautics is an essential element of our national economy, they asked only that all possible steps be taken to minimize nuisance and hazard."

Throughout its report the commission emphasized that community exposure to aircraft noise constituted a serious national problem and recommended strong measures to deal with it. The following quotations are taken from pages 8,9 and 10:

> "...the problem of control of the use of the land in approach zones becomes more difficult because of the large area involved. For reasons shown elsewhere in this report, it would be desirable to protect approaches to dominent runways for a distance of at least two miles beyond the runway extensions ("at least one-half mile beyond the end of the dominent runways. These areas should be incorporated within the boundaries of the airport.")
>
> "Where it is not economically feasible to purchase such tracts of land so that absolute control of their use could be maintained, reliance must be placed on zoning laws to protect both the aircraft using the airport from obstructions to flight and the people on the ground from hazard and noise."
>
> "Traditionally the power to control the use of land rests with the states and may be delegated to counties and local communities. The federal government should, however, propose model airport protective legislation for enactment by the states, and should help where practicable toward reaching a satisfactory solution of this type of zoning problem."
>
> "...It is further suggested that the federal government commit no funds for new airport construction unless the state, or other local authority, gives reasonable assurance that the air approaches to the airport will be protected in accordance with the recommendations made herein. The land under the approaches should not be put to any use which might later serve as a basis for an effective argument that the space above should not be used by aircraft."
>
> "Future residents should not be given any grounds for claims that aircraft approaching or departing

> from the airport, or which may be involved in accidents, create a nuisance which entitles them to an injunction to recover damages or to demand that the airport be closed."
>
> "Local zoning authorities should employ their powers to prohibit further development which will interfere with appropriate use of existing airports. Here also availability of federal funds should be dependent upon such local action."

The following quotations are also taken from the Report of the President's Airport Commission (p. 12-13) under the heading "Nuisance Factors":

> "Some excuse may be found for failure to have forseen the rapid rate of aeronautical progress in designing airports in the past, but it is to be regretted that more consideration was not given to the comfort and welfare of people living on the ground in the vicinity of airports. To be sure, many settled near an airport after it was in operation, with little realization of the potential nuisance and hazard. The public cannot be expected, however, to anticipate technical developments and it should be informed and protected by the responsible authorities."
>
> "The public deserves a clear explanation of necessary airport procedures accompanied by valid assurances that everything possible is being done to alleviate both noise and hazard. The public will understand and accept this necessity if it is assured that, within the limit of safe operation, the holding areas are selected so that the stacks will not be a source of nuisance. Also where operators are making a sincere effort to reduce engine run-up noise by controlled ground procedure and by the provision of proper acoustical treatment, and are avoiding take-offs over inhabited areas, reasonable people can be persuaded to tolerate some noise as a part of the cost of living in this age of technology. Operators, pilots and airport controllers must be indoctrinated to consider the people on the ground and make every effort consistent with safe flying practice to reduce hazard and noise."

The purpose in quoting extensively from the commission's report is to establish an authoritative background for comparing today's airport noise problem and recommendations for its solution with the same problem as it was defined twenty years ago. The report is understood to be out of print and no longer available from the Government Printing Office.

EARLY CONGRESSIONAL INTEREST

From September 1959 to December 1962, subcommittees of the U. S. House of Representatives Committee on Interstate and Foreign Commerce conducted a series of hearings at major airport locations. The report(3) entitled "Aircraft Noise Problems," describes in some 750 pages most aspects of the "problem" per se but unfortunately the hearings failed to result in legislation. The list of names of those testifying reads like the "Who's Who" of airport community leaders, their Congressional representatives and aviation industry officials concerned with aircraft noise.

EPA AND NASA INTEREST IN AIRCRAFT NOISE

The views expressed during 1959-62 are remarkably similar to those expressed in testimony during public hearings conducted by the Office of Noise Abatement and Control of the Environmental Protection Agency during 1971.

In accordance with the Noise Pollution and Abatement Act of 1970 together with Title IV of the Clean Air Act of 1970, the EPA issued the "Report to the President and Congress on Noise" (4) dated 31 December 1971. In the report, the EPA concluded that the "Application of available technology is lagging because of inadequate social, economic or governmental pressures for noise abatement." Further, "...there must be a balance between application of technology to noise sources and the other measures required in controlling the total noise environment, such as land use planning and regulation of source use." The report also states that there exists adequate authority under such legislation as the National Environmental Policy Act of 1969, applicable to all federal agencies for the exercise of control of noise from many sources including aircraft. However, unless such control is exercised, residual" (the lower level boundary that is exceeded approximately 90% of the time) community noise levels are expected to rise by 4 dBA by the year 2000. This requires more than a doubling of sound energy and is in spite of the fact that new aircraft and presumably other vehicles and machinery will be individually less noisy. The reason is that increased numbers will tend to keep total exposure levels growing.

In its assessment of the magnitude of the problem associated with aircraft noise, the EPA estimates that some 2000 square miles were impacted in 1970 with approximately 3300 square miles by the year 2000. Additional documentation on the scale of the problem from the standpoint of numbers of people exposed to aircraft noise was provided recently by the NASA. According to a report in the Aviation Daily (5) NASA Ames Research Center has data indicating that in 1968 an area of 1300 square miles containing 15 million people was subjected to a Noise Exposure Forecast (NEF) level of 30 or greater. This was an increase from 100 square miles and one million people in 1958 and that without corrective action, it is estimated to be 1,800 square miles and 24 million people in 1978. It is important to note here that there is agreement among some federal agencies upon not only the magnitude of the aircraft noise problem but upon the use of the NEF as a unit of cumulative noise exposure. Further, that above the 30 NEF level, residential use is unacceptable and that effective measures to reduce community exposure to aircraft noise are available for immediate implementation.

BOEING COMPANY RECOMMENDATIONS AND INDIVIDUAL AIRLINE PROGRAMS

In June 1971, Boeing Company employees presented a paper entitled "Effects of Aircraft Operation on Community Noise"(6). At the concluding EPA public hearing on noise pollution in Washington, D. C., November 10, 1971, Boeing representatives officially restated the company's position regarding the applicability of operating procedures to significantly reduce community noise as follows:

> "1. Significant reductions in community noise can be attained through early adoption of readily available regulatory and procedural operations changes in the vicinity of airports. Such changes can be made at little (or 'nominal') cost, would require no particular increase in pilot skill or pilot workload, and are not considered to have any effect on safety.
> "2. Further noise reduction benefits are available through certain additional operating procedures requiring development of techniques and equipment modifications to avoid increasing pilot workload."

Boeing also recommended that mandatory noise abatement operating procedures "be an inherent part of the overall effort to reduce community annoyance.

In August and September 1971, under contract with NASA-Ames Research Center, American Airlines conducted an investigation(7) of a two segment approach procedure using area navigation equipment, having three dimensional capability, and other instrumentation. The noise benefits were reported tentatively to be on the order of 17-18 dB to a point 1.3 n.m. from touchdown. The final report on this program has not yet been made public. Figure (1) is an unofficial instrument approach procedure plate describing the two-segment approach procedure employed in flight tests using Stockton California airport and ILS. (Note: glide slope angle set at two degrees, thirty minutes.)

Some time ago, North Central and Northwest, the two home based airlines at the Minneapolis-Saint Paul International Airport, recognized the benefits available to airport community residents through the adoption of relatively simple operating procedures which cost the company essentially nothing. Flight Standards Bulletin No. 3-70 (Appendix A) of Northwest describes in particularly clear terms the "why" and the how of an excellent noise abatement takeoff procedure. It should be noted that NWA sets no arbitrary limitation on deck angle and that a range of actual weights used on takeoff determines the target thrust reduction EPR rather than

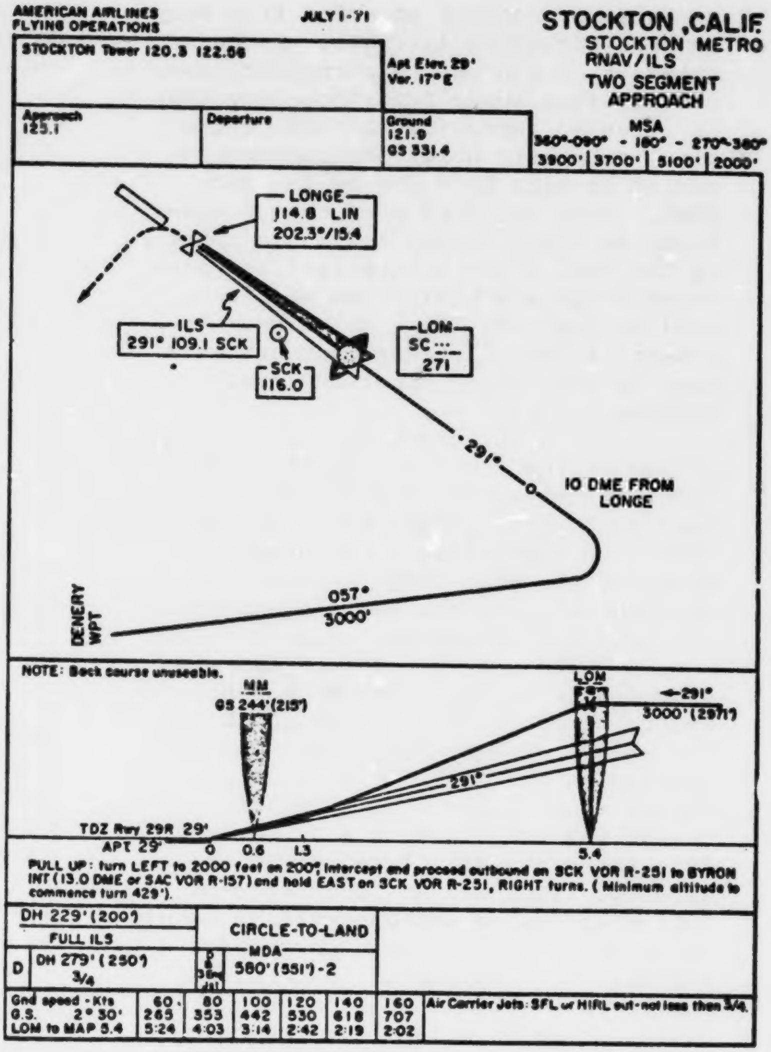

AMERICAN AIRLINES
FLYING OPERATIONS
JULY 1-71
STOCKTON ,CALIF.
STOCKTON METRO
RNAV/ILS
TWO SEGMENT
APPROACH
STOCKTON Tower 120.3 122.56
Apt Elev. 29'
Var. 17° E
Approach
125.1
Departure
Ground
121.9
GS 331.4
MSA
360°-090° - 180° - 270°-360°
3900' 3700' 5100' 2000'
LONGE
114.8 LIN
202.3°/15.4
ILS
291° 109.1 SCK
SCK
116.0
LOM
SC
271
291°
10 DME FROM
LONGE
DENERY
WPT
057°
3000'
NOTE: Back course unuseable.
MM
GS 244'(215')
LOM
→291°
3000'(2971')
291°
TDZ Rwy 29R 29'
APT 29'
0
0.6
1.3
5.4
PULL UP: turn LEFT to 2000 feet on 200°, intercept and proceed outbound on SCK VOR R-251 to BYRON INT (13.0 DME or SAC VOR R-157) and hold EAST on SCK VOR R-251, RIGHT turns. (Minimum altitude to commence turn 429').
DH 229'(200')
FULL ILS
D
DH 279'(250')
3/4
CIRCLE-TO-LAND
MDA
580'(551')-2
Gnd speed - Kts
G.S. 2° 30'
LOM to MAP 5.4
60 265 5:24
80 353 4:03
100 442 3:14
120 530 2:42
140 618 2:19
160 707 2:02
Air Carrier Jets: SFL or HIRL out-not less than 3/4.

Fig. 1 - Instrument Approach Procedure plate (unofficial) showing two segment approach using area navigation and instrument landing system (ILS)

assuming every takeoff is made at maximum gross weight.

Captain Paul Soderlind, Director, Flight Operations-Technical, Northwest, has developed a simple modification to the flight director computer helping the pilot to keep the aircraft above the ILS glide slope. Refering to this technique as the "High Flight Director" approach, Captain Soderlind described it in a letter to Administrator Shaffer in November 1970. Implementation of the HFD requires FAA recertification of the flight director. Its use results in noise reductions measured under the approach path on the order of 3 to 6 dB.

It may be of interest to take note of Senator Warren G. Magnuson's letter of July 26, 1971, to Administrator Shaffer. As a token of response to increased pressure from noise afflicted constituents living near the Seattle-Tacoma International Airport Senator Magnuson said, "I am tired of promises both from the Agency and from the airlines. Unless there is a prompt attempt to prescribe and enforce 'voluntary' noise abatement procedures, I will begin steps designed to ease the situation by other methods." Let us hope that Senator Magnuson's "other methods" would be as helpful to all other airport community residents as well.

HUD CONTRIBUTION TO THE IANAP

Certainly the most significant accomplishments to date on the part of the Interagency Aircraft Noise Abatement Program have resulted through the participation of the U. S. Department of Housing and Urban Development. Under the chairmanship of Richard H. Broun, Director, Environmental Planning Division of HUD, the Land Use/Airports Study Panel of the IANAP has reviewed studies sponsored by HUD which have resulted in important policy decisions and actions at headquarters and field levels.

Departmental Circular 1390.2 (8) dated August 4, 1971, established for the first time a federal requirement for aircraft noise exposure policies and standards. It should be noted that NASA and HUD, together with recognized technical experts including those at FAA headquarters, believe that cumulative noise exposure expressed in units such as NEF, CNR, the British NNI, the German "Q" scale and others, is the most valid method of measuring aircraft noise from the standpoint of assessing the magnitude of the problem at any airport community location. This is necessary for comprehensive airport/community planning using aircraft noise exposure, not merely individual noise level (EPNL), as an environmental factor to be accounted for.

In May 1970, HUD published its first environmental planning paper entitled "Airport Environs: Land Use Controls"(9). The document summarizes in part:

> "The comprehensive planning process for compatible land use and airport development is directed toward achieving an optimum relationship between an airport and its environs. As such planning for compatible land use in the airport environs and planning for the airport itself should be integral parts of an areawide comprehensive planning program whereby airport policies and programs are coordinated with objectives, policies and programs for the area in which the airport is located."

BRITISH POSITION

A recent report(10) of the official Noise Advisory Council in England concluded:

> "...It is essential that planning for airport operation and expansion and for future local land use development should proceed hand-in-hand; for property development, a form of zoning based on predicted air traffic noise contours (ed. The Council also recommended elsewhere in its report the use of the Noise and Number Index --NNI) and the sizes of populations likely to be affected is necessary; complimentary control over airport operation and expansion is the other necessary side of the picture and standards and policies should be consistent across the counter under Ministerial guidance; account should be taken of the noise implications of airports in the devising of regional strategies."

DOT/FAA CONTRIBUTIONS TO AIRCRAFT NOISE ABATEMENT

It is rumored that last December, Administrator Shaffer instructed FAA personnel that no longer would the FAA support for use internally by HUD or others, the NEF, the most recently developed unit of cumulative noise exposure. At a public meeting of the Minneapolis-Saint Paul Metropolitan Airports Commission on February 7, 1972, Mr. Ed Sellman of the FAA's Office of Environmental Quality gave a presentation using viewgraphs in which he described noise levels of various aircraft in terms of contours of equal noisiness, i.e. EPNL, without reference to the NEF. This in itself would not merit criticism. However, noise levels produced by different current aircraft were compared. Mr. Sellman appeared to exaggerate the noise reductions obtained with newer aircraft. Since there was no printed handout it is necessary to refer to memory for an example. The 100 EPNL contour for the Boeing 747B on takeoff was shown to enclose an area approximately one fifth or 80% less than that of the 747A model at equivalent weights and pilot procedures which include thrust cutback prior to reaching the measurement point. The point is that the FAA could be trying to minimize the noise problem to be expected in the future. This tactic is consistent with the FAA's previous public statements regarding the impact of jet aircraft noise.

Administrator Shaffer should be required to publically respond to the following questions:

1. Whether or not he has instructed FAA personnel to cease using the NEF. If so, why?

2. Is the FAA deliberately attempting to mislead the public by making false comparisons between noise levels produced by current aircraft as well as in projections of future aircraft noise levels?

Before jets were introduced in commercial service in November 1959, the public was told by the FAA that these new aircraft would produce no more noise than current piston types. Accordingly, the Port of New York Authority based its 112 PNdB standard on maximum noise levels generated by Lockheed Constellation and Douglas DC-7 type aircraft. Thus, the limit had nothing to do with community acceptability or to total community noise exposure. Residents in the vicinity of PNYA airports in common with those of other major airport communities, experienced not only a greater and far more annoying source of noise but an ever continuing escalation of exposure due to increased operations.

Mr. Thomas K. Jordan, Chief of Transport Development, Wisconsin Department of Transportation, has prepared "A Proposal for Creating Compatible Environments in the Vicinity of Municipal Airports for the Benefit of the Public Welfare."(11) Writing as a consultant to the Office of Aviation Policy and Plans (AV-1) FAA, Mr. Jordan stated that "the concern over airport neighborhood environments and need to resolve the conflicts in the protection of public welfare may prove to be the most significant and beneficial development for the full and unrestricted use of the air space for transport that has taken place." Mr. Jordan also offered "principles for a model act...for consideration as one approach to state legislation that is vitally necessary for the beneficial development of the environment in airport neighborhoods." Such "principles" include making state aeronautics agencies responsible for airport environmental compatibility, establishment of required zoning, etc.

It should be recalled that Mr. Jordan is an official of a state aeronautics agency and may therefore wish to see a single purpose aviation agency retain control over the situation although the actions he calls for are certainly needed regardless of who accomplishes them.

In a recent letter(12) to the Chairman of the Minneapolis-Saint Paul Airports Commission, Administrator Shaffer ignores environmental problems facing the Commission as he states:

> "We fully expect Wold-Chamberlain to be retained within your metro system and this nation's airport system and that it continue to serve as a major airport to accommodate the demand of your region's commercial aeronautical requirements."

This should be compared to the statement (13) of Mr. Benjamin G. Griggs, Jr., Vice President and Assistant to the President, Northwest Airlines, Inc., regarding the need for developing a new airport to replace the Minneapolis-Saint Paul International Airport (Wold-Chamberlain Field). On February 9, 1972, he said, "If there is a necessity to move aircraft operations from Wold-Chamberlain, it is only because of the noise/ecology problem." Further, "The only solution to the noise/ecology problem may be the closing of Wold-Chamberlain and the construction of a new larger airport with appropriate zoning protection around it."

According to the Aviation Daily of 16 February 1972, Mr. Shaffer told the Wings Club of New York that "aircraft noise won't be an issue by 1978." It was just this sort of prediction in the past which has led to the present predicament. There are few technical experts who would agree with Shaffer's prediction which appears to be based on political rather than technical considerations.

With the apparent exception of Administrator Shaffer, there is almost universal agreement upon the validity of using some index of cumulative noise exposure. In the case of the NEF there is the further agreement that the standard of acceptability for residential areas should be less than 30, as both HUD and NASA have indicated. Experts do acknowledge, however, that neither the NEF nor any of the other indices of cumulative exposure is perfect. There is also a high degree of correlation among these indices when they are plotted on a common graph. Certainly one cannot argue that land use planning itself is a more exact science, one for which a given noise exposure will always be either acceptable or unacceptable.

The entire public, including those who regularly use the scheduled air carriers and who are subjected to airport and airways congestion as well as those who seldom if ever fly but live in areas of excessive exposure to noise from commercial and private aircraft, is entitled to truthfulness, decisions and action on the part of governmental agencies.

The Interagency Aircraft Noise Abatement Program (IANAP) was established in 1965, originally under the auspices of the President's Office of Science and Technology (OST). In its report entitled "Alleviation of Jet Aircraft Noise Near Airports"(14), dated March 1966, a panel of the nation's experts known as the Program Evaluation and Development Committee (PEDC), made the recommendations summarized below:

Recommendation 1: Determine on an urgent basis how the jet aircraft noise problem is likely to develop.

Recommendation 2: "A high level governmental task force...be established to undertake, on an urgent basis, an overall 'systems' type analysis of the jet aircraft noise problem...in order to formulate programs, suitable for federal sponsorship, which might be undertaken to improve greatly the capabilities of those communities to cope with...jet aircraft noise..." Further, that "Adequate guidelines for 'small' airports must be provided in order to avoid the development of new problems during the next decade... this 'preventative' planning will assure large savings in the future."

Recommendation 3. Conduct a Government study to determine "applicable economic facts and relationships, and of public policy issues which must be formulated and/or applied in order to provide the needed cost allocation rationale."

Recommendation 4. The FAA and/or NASA develop noise evaluation techniques and standards to be used by airport operators and others and be "compatible with international noise rating schemes aimed at preventing nuisance or detriment to public health."

Recommendation 5. Determine relative costs to diminish generated noise in terms of R & D, procurement, and direct and indirect operating costs.

Recommendation 6. The FAA should undertake detailed studies to determine safety factors, guidance and control instrumentation needs, air traffic control procedures, etc.

Recommendation 7. The FAA should determine (ed. and presumably require the use of) optimum operating procedures for noise reduction.

Recommendation 8. The federal government should influence real estate development near airports to either "anticipate or ameliorate community aircraft noise problems."

In August 1967, leadership of the federal aircraft noise abatement program was transferred from OST to DOT. With the exception of the work of HUD which chairs the Land Use/Airports Study Panel referred to above and perhaps the FAA's aircraft type certification for noise, a program specifically required by Congress, there is little else for which the IANAP can be credited for reducing community exposure to aircraft noise.

In the published conclusions of the SAE/DOT Conference on Aircraft and the Environment(15) held in Washington D.C. February 8-10, 1971, officials in the DOT Office of Noise Abatement (coordinator of the IANAP) recommended essentially only more study with one notable exception. Recommendation 10 said, "The Federal Government should act immediately to preempt all facets of the airport/aircraft noise problem. The FAA should take definite actions with respect to operational noise abatement procedures."

Here we have at least one call for action on the part of an aviation regulatory agency, in this case the DOT. It would seem then that if the DOT tells the FAA it must "take definite actions" etc., the FAA would do so. However, in this case the FAA has not done so. However, let's look briefly at the question of federal preemption. In testifying(16) at the EPA public hearing in Washington D. C. November 10, 1971, Michael M. Berger described the FAA legal position on the preemption issue as "schizophrenic." Mr. Berger claims, "The FAA has successfully been playing games with the federal courts and the millions of citizens around the nation who are adversely affected by airport noise. The games have as their object the achievement of the ultimate in bureaucratic buck-passing -- do whatever is necessary to avoid facing the problem."

In the summary of this testimony, Mr. Berger concluded that, "Government at the administrative (ed. FAA) level has abdicated. There has been no step taken by the Federal Government that has provided one decibel of relief. The new regulations (ed. noise certification) will not bring relief, if at all, for a decade. If one wants to see the epitomization of stalling, buck-passing and bureaucratic obeissance to regulators to those they are supposed to regulate, here is a case in point."

CONCLUSIONS

It must be obvious today to even the most cynical anti-environmentalist that public opposition to airport noise will continue to increase with increasing total exposure even though new aircraft types are individually quieter. Fortunately, the public is becoming more knowledgeable about means available to reduce noise thanks to the enlightenment of the Boeing Company and other primary manufacturers who have long realized that the aircraft noise problem must be faced if they were to continue to find markets for their products.

The unfortunate demise of the U. S. SST, the cessation or delay of the Everglades Palmdale and other major airport developments, must surely have alerted aviation leaders at least to the serious credibility gap existing between them and the public.

The public has become blase about technological achievement. If one doubts this, check the Nielsen ratings for the last Apollo flight. The public is now "turned on" on environemntal improvement.

Since President Truman's Commission issued its report in 1952, we have witnessed twenty years of non-action on the part of aviation regulatory agencies in meeting statutory(17) and moral obligations to the public. It must be concluded that it is not an individual or group which is at fault, but the system itself. Administrator Shaffer should not be blamed any more than his predecessors including Mr. Horne. Both of these administrators publicly acknowledged that community exposure to aircraft noise was a serious problem. It must be concluded that aircraft noise is only a problem to CAA/FAA administrators as it constrains their primary purpose, that of promoting air transportation.

Since air transportation is indeed essential, it follows that the constraints imposed upon the development of new airport facilities and aircraft by public opposition to noise and sonic boom must be dealt with in the most effective and expeditious manner. This does not seem likely to occur even with air transportation suffering ever-increasing constraints unless the present federal administrative organization of regulatory responsibility is changed.

In its "Report to the President and Congress on Noise"(4) dated December 31, 1971, the EPA concluded after public hearings throughout the country and after receiving testimony from many witnesses, that the "Application of available technology is lagging because of inadequate social, economic or governmental pressures for noise abatement." Further, that existing legislation provides a basis for noise control associated with both planned and existing federal activities." While it is undoubtedly true that adequate authority exists for the FAA to effectively control community exposure to aircraft noise, there is clearly great negative motivation to use such authority, hence the need for organizational change.

According to a report(18) on conclusions reached recently by the Airlines & Aircraft Sub-Council of the National Industrial Pollution Control Council, major changes in the government's approach to aircraft noise reduction are needed. The Council, headed by C.C. Tillinghast, with C. A. Moore representing airport operators, recommended that "a single agency be given responsibility" for developing noise measurement standards and regulations, etc. Significantly, the FAA was not recommended as the single agency.

If we have learned anything in dealing with the aircraft noise problem since 1952, we know that a reorganization of administrative responsibilities is necessary -- for the public as well as aviation's benefit.

It should be pointed out that the administration's Noise Control Act of 1971, part of the President's 1971 Environmental Program(19), would involve the EPA in only a limited manner in that:

> "(C) If at any time the Administrator of the Environmental Protection Agency has reason to believe that an existing standard, rule, or regulation under this section does not protect the public from aircraft noise or sonic boom to the maximum extent that is consistent with the consideration listed in subsection (D) of this section, he may request the Administrator of the Federal Aviation Administration to review and report to him on the advisability of revising such standard, rule, or regulation, etc." (underlining supplied)

Even this weak language was diluted in House of Representative's action in committee(20) and floor action on February 29, 1972, in passing H.R. 11021 following aviation interest's urging(21). Aviation's supporters still fail to heed the public's message.

RECOMMENDATIONS

In order to overcome existing difficiencies, the Congress is urged to enact legislation for two purposes -- one a short term and the other a long term measure -- to accomplish immediate alleviation while working for the early resolution of the aircraft noise problem as follows:

A. Short term -- require the FAA to immediately implement conclusion #1 of the Boeing Co. Report(6) and, together with NASA and industry, develop equipment needed for the implementation of conclusion #2 on an urgent basis. The FAA should also be required to render a report to Congress at the end of this and succeeding years on the status of these efforts.

B. Long term -- authorize the EPA to develop and coordinate the implementation of national "guidelines" for maximum aircraft noise exposure impact in all airport communities within the United States based upon current and predicted operations. These guidelines would be established by the EPA after consultation with FAA, NASA, HUD, HEW, Department of Interior, etc. for a range of compatible land use programs. Such guidelines would establish geographical boundaries for noise exposure contours at all airports upon which federal funds have been expended based on:

1. predicted passenger and flight traffic;
2. possible changes in aircraft and aircraft operations based on existing and known technology; and
3. land use in the airport environs and possible changes in land use.

The EPA would also be required to provide technical assistance to the operator of any airport who requests such assistance in meeting established guidelines. An annual report to the Congress would be required.

Note: Minnesota has set an example for state recognition of responsibility for the concurrent protection of airport facilities and the community environment. This was recognized by the FAA and the Airport Operators Council International in the joint document, "Planning the Metropolitan Airport System," dated May 1970(22). Chapter 1111, 1969 Minnesota Session Laws, referred to as the "Airport Zoning Act"(23), empowers a generalist regional planning agency to establish mandatory guidelines for the control of zoning, building code ordinances, official maps and subdivision regulations within five (5) miles of any new major airport. Aircraft noise abatement is, of course, specifically identified as the purpose.

It is submitted that only by substituting a generalist planning/environmental agency (EPA) for the single-purpose functional district (FAA/DOT) agency, can current and future problems constraining the growth of aviation be overcome. It is perhaps paradoxical that, in their dedicated efforts to promote aviation, the CAA/FAA/DOT are in fact responsible for the current decline in public support. Since the FAA/DOT is manifestly unable to "change its spots" a restructuring of responsibility is necessary.

REFERENCES

1. Dr. Alvin F. Meyer, Jr., Director, Office of Noise Abatement and Control, U. S. Environmental Protection Agency, letter to Lloyd Hinton, December 2, 1971.

2. Report of the President's Airport Commission, "The Airport and Its Neighbors," U.S. Government Printing Office, Washington, D.C., May 16, 1952.

3. "Aircraft Noise Problems," a report of hearings before subcommittees of the Committee on Interstate and Foreign Commerce, U.S. House of Representatives (86th and 87th Congresses), September 7, 1959; February 23, April 20, 21, 1960; April 12, 1961; July 17, 18, December 4, 5 and 6, 1962; U.S. Government Printing Office, Washington, D.C. 1963.

4. "Report to the President and Congress on Noise," U.S. Environmental Protection Agency, Washington, D.C., December 31, 1971.

5. "Ames Researcher Reviews Cost of Noise and Congestion," Aviation Daily, page 134, Ziff-Davis Publishing Co., Washington, D.C. 20005, January 25, 1972.

6. M.C. Gregoire and J.M. Streckenbach, "The Effects of Aircraft Operation on Community Noise," The Boeing Company Commercial Airplane Group, Seattle, Washington, June 1971.

7. "Evaluation of Three Dimensional Area Navigation for Jet Transport Noise Abatement, a 30-day Flight Test of Modified Boeing 720B at Moffett Field and Stockton Airport, California," American Airlines and NASA-Ames Research Center, American Airlines, Inc., New York, N.Y. 10017, 15 July 1971.

8. Departmental Circular 1390.2, "Noise Abatement and Control: Departmental Policy, Implementation Responsibilities and Standards," U.S. Department of Housing and Urban Development, Washington, D.C., August 4, 1971.

9. Environmental Planning Paper, "Airport Environs: Land Use Controls," Environmental Planning Division, U.S. Department of Housing and Urban Development, Washington, D.C. 20410, May 1970.

10. "Aircraft Noise: Flight Routeing Near Airports," Report of The Noise Advisory Council, Her Majesty's Stationery Office, London, England, 1971, p. 23.

11. Thomas K. Jordan, P.E., "A Proposal for Creating Compatible Environments in the vicinity of Municipal Airports for the Benefit of the Public Welfare," Office of Aviation Policy and Plans (AV-1), Federal Aviation Administration, U.S. Department of Transportation, Washington, D.C., 20590, April 1, 1971, p. 10.

12. John H. Shaffer, Administrator, Federal Aviation Administration, letter to Lawrence M. Hall, Chairman, Minneapolis-Saint Paul Metropolitan Airports Commission, January 18, 1972.

13. Benjamin G. Griggs, Jr., Vice ~~Pre~~ President, Northwest Airlines, Inc., statement before special meeting of the Minneapolis-Saint Paul Metropolitan Airports Commission with airline representatives to consider "Future Planning and Airport Development to Accommodate the Needs of Air Transportation in the Minneapolis-Saint Paul Metropolitan Area," Saint Paul, Minnesota 55111, February 9, 1972.

14. "Alleviation of Jet Aircraft Noise Near Airports," a Report of the Jet Aircraft Noise Panel, Office of Science and Technology, Executive Office of the President, U.S. Government Printing Office, Washington, D.C. 20402, March 1966.

15. "Conference on Aircraft and the Environment," sponsored jointly by the Society of Automotive Engineers, Inc. and the U.S. Department of Transportation, Washington, D.C., February 8-10, 1971, p. 97. Proceedings published by the Society of Automotive Engineers Inc., Two Pennsylvania Plaza, New York, N.Y..10001, 1971.

16. Michael M. Berger, "Games the FAA

Plays," Testimony before public hearings conducted by the Office of Noise Abatement and Control, U.S. Environmental Protection Agency, Washington, D.C., November 10, 1971.
Note: Mr. Berger is associated with Fadem and Kanner, 8383 Wilshire Boulevard, Beverly Hills, California 90211.

17. Federal regulatory acts having clauses relating to aviation development and environmental protection.
  a. Federal Aviation Act of 1958 (49 U.S.C., Sec. 307 (c))
  b. Department of Transportation Act of 1966 (Public Law 89-670)
  c. Federal Airport Act of 1964 (49 U.S.C., Sec. 1110, 1431 (4)) known as the "FAAP" act.
  d. "An Act for the Control and Abatement of Aircraft Noise and Sonic Boom," (Public Law 90-411) enacted 21 July 1968.
  e. National Environmental Policy Act of 1969 (Public Law 91-190)
  f. Airport and Airways Development Act of 1970 (Public Law 91-258)
  g. Noise Pollution and Abatement Act of 1970 (Public Law 91-604, Sec. 402 (c))

18. "Change in Noise Reduction Approach Urged," Aviation Week & Space Technology, McGraw-Hill, Inc., March 6, 1972, p. 25.

19. "The President's 1971 Environmental Program," compiled by the President's Council on Environmental Quality, March 1971, U.S. Government Printing Office, Washington, D.C. 20402.

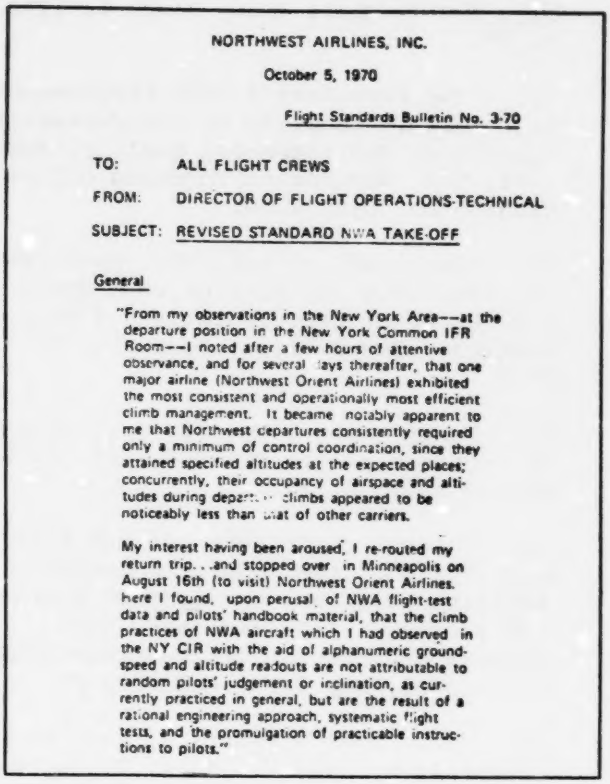
20. Report No. 92-842, The Committee on Interstate and Foreign Commerce, U.S. House of Representatives 92nd Congress, 2nd Session, February 19, 1972.

21. Congressional Record, U.S. House of Representatives, February 29, 1972, pp. H. 1507, H. 1539.

22. "Planning the Metropolitan Airport System," the Federal Aviation Administration and the Airport Operator's Council International, U.S. Government Printing Office, Washington, D.C. 20402, May 1970, Appendix F.

23. "New Major Airport; Airport Development Area," Sec. 1, Subd. 1, Metropolitan Council; Land Use Criteria and Guidelines," Chapter 1111, 1969 Session Laws, Minnesota.

APPENDIX



NORTHWEST AIRLINES, INC.

October 5, 1970

Flight Standards Bulletin No. 3-70

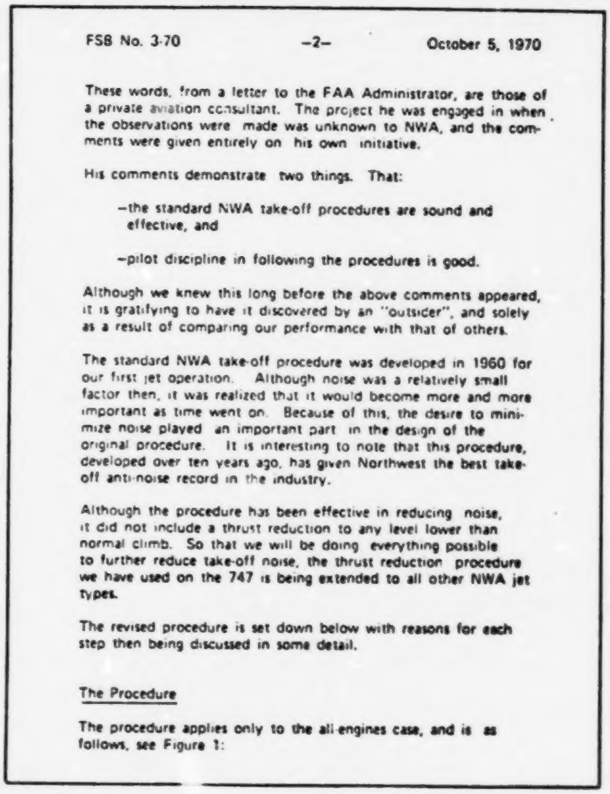
TO: ALL FLIGHT CREWS

FROM: DIRECTOR OF FLIGHT OPERATIONS-TECHNICAL

SUBJECT: REVISED STANDARD NWA TAKE-OFF

General

> "From my observations in the New York Area––at the departure position in the New York Common IFR Room––I noted after a few hours of attentive observance, and for several days thereafter, that one major airline (Northwest Orient Airlines) exhibited the most consistent and operationally most efficient climb management. It became notably apparent to me that Northwest departures consistently required only a minimum of control coordination, since they attained specified altitudes at the expected places; concurrently, their occupancy of airspace and altitudes during departure climbs appeared to be noticeably less than that of other carriers.
>
> My interest having been aroused, I re-routed my return trip. . .and stopped over in Minneapolis on August 16th (to visit) Northwest Orient Airlines. There I found, upon perusal of NWA flight-test data and pilots' handbook material, that the climb practices of NWA aircraft which I had observed in the NY CIR with the aid of alphanumeric ground-speed and altitude readouts are not attributable to random pilots' judgement or inclination, as currently practiced in general, but are the result of a rational engineering approach, systematic flight tests, and the promulgation of practicable instructions to pilots."



These words, from a letter to the FAA Administrator, are those of a private aviation consultant. The project he was engaged in when the observations were made was unknown to NWA, and the comments were given entirely on his own initiative.

His comments demonstrate two things. That:

–the standard NWA take-off procedures are sound and effective, and

–pilot discipline in following the procedures is good.

Although we knew this long before the above comments appeared, it is gratifying to have it discovered by an "outsider", and solely as a result of comparing our performance with that of others.

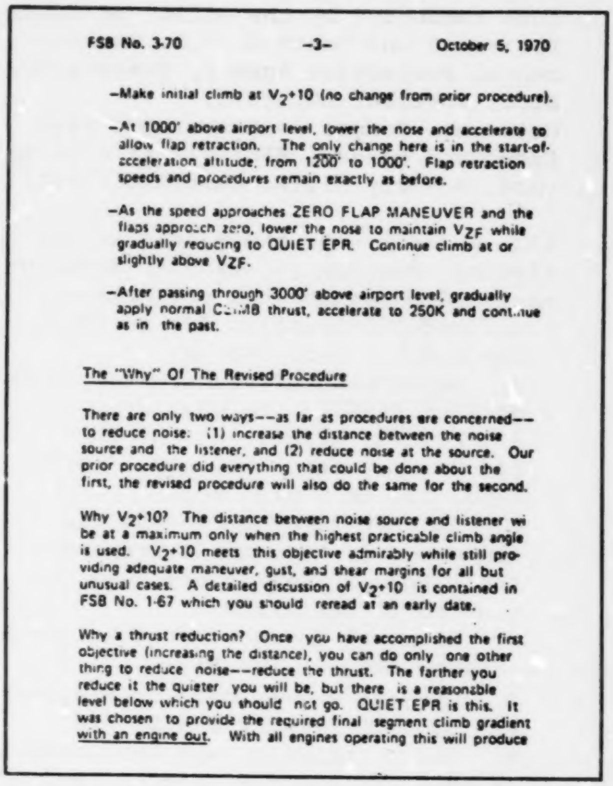
The standard NWA take-off procedure was developed in 1960 for our first jet operation. Although noise was a relatively small factor then, it was realized that it would become more and more important as time went on. Because of this, the desire to minimize noise played an important part in the design of the original procedure. It is interesting to note that this procedure, developed over ten years ago, has given Northwest the best take-off anti-noise record in the industry.

Although the procedure has been effective in reducing noise, it did not include a thrust reduction to any level lower than normal climb. So that we will be doing everything possible to further reduce take-off noise, the thrust reduction procedure we have used on the 747 is being extended to all other NWA jet types.

The revised procedure is set down below with reasons for each step then being discussed in some detail.

The Procedure

The procedure applies only to the all-engines case, and is as follows, see Figure 1:



–Make initial climb at V_2+10 (no change from prior procedure).

–At 1000' above airport level, lower the nose and accelerate to allow flap retraction. The only change here is in the start-of-acceleration altitude, from 1200' to 1000'. Flap retraction speeds and procedures remain exactly as before.

–As the speed approaches ZERO FLAP MANEUVER and the flaps approach zero, lower the nose to maintain V_{ZF} while gradually reducing to QUIET EPR. Continue climb at or slightly above V_{ZF}.

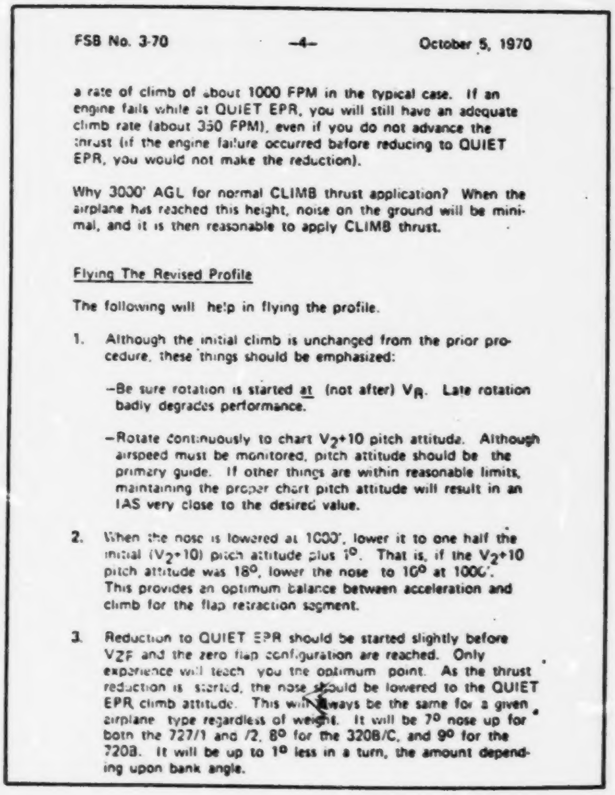
–After passing through 3000' above airport level, gradually apply normal CLIMB thrust, accelerate to 250K and continue as in the past.

The "Why" Of The Revised Procedure

There are only two ways––as far as procedures are concerned––to reduce noise: (1) increase the distance between the noise source and the listener, and (2) reduce noise at the source. Our prior procedure did everything that could be done about the first, the revised procedure will also do the same for the second.

Why V_2+10? The distance between noise source and listener wi be at a maximum only when the highest practicable climb angle is used. V_2+10 meets this objective admirably while still providing adequate maneuver, gust, and shear margins for all but unusual cases. A detailed discussion of V_2+10 is contained in FSB No. 1-67 which you should reread at an early date.

Why a thrust reduction? Once you have accomplished the first objective (increasing the distance), you can do only one other thing to reduce noise––reduce the thrust. The farther you reduce it the quieter you will be, but there is a reasonable level below which you should not go. QUIET EPR is this. It was chosen to provide the required final segment climb gradient with an engine out. With all engines operating this will produce



a rate of climb of about 1000 FPM in the typical case. If an engine fails while at QUIET EPR, you will still have an adequate climb rate (about 350 FPM), even if you do not advance the thrust (if the engine failure occurred before reducing to QUIET EPR, you would not make the reduction).

Why 3000' AGL for normal CLIMB thrust application? When the airplane has reached this height, noise on the ground will be minimal, and it is then reasonable to apply CLIMB thrust.

Flying The Revised Profile

The following will help in flying the profile.

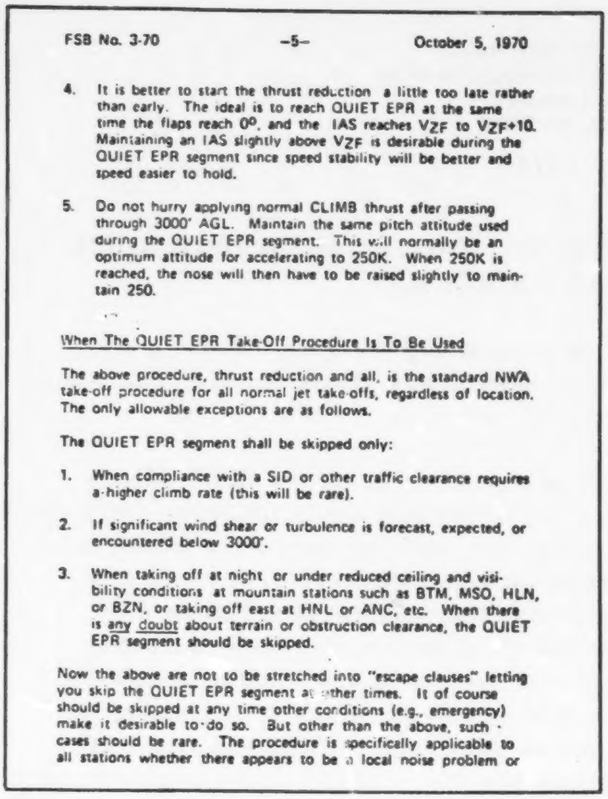
1. Although the initial climb is unchanged from the prior procedure, these things should be emphasized:

   –Be sure rotation is started at (not after) V_R. Late rotation badly degrades performance.

   –Rotate continuously to chart V_2+10 pitch attitude. Although airspeed must be monitored, pitch attitude should be the primary guide. If other things are within reasonable limits, maintaining the proper chart pitch attitude will result in an IAS very close to the desired value.

2. When the nose is lowered at 1000', lower it to one half the initial (V_2+10) pitch attitude plus 1°. That is, if the V_2+10 pitch attitude was 18°, lower the nose to 10° at 1000'. This provides an optimum balance between acceleration and climb for the flap retraction segment.

3. Reduction to QUIET EPR should be started slightly before V_{ZF} and the zero flap configuration are reached. Only experience will teach you the optimum point. As the thrust reduction is started, the nose should be lowered to the QUIET EPR climb attitude. This will always be the same for a given airplane type regardless of weight. It will be 7° nose up for both the 727/1 and /2, 8° for the 320B/C, and 9° for the 720B. It will be up to 1° less in a turn, the amount depending upon bank angle.



FSB No. 3-70 -5- October 5, 1970

4. It is better to start the thrust reduction a little too late rather than early. The ideal is to reach QUIET EPR at the same time the flaps reach 0°, and the IAS reaches V_{ZF} to $V_{ZF}+10$. Maintaining an IAS slightly above V_{ZF} is desirable during the QUIET EPR segment since speed stability will be better and speed easier to hold.

5. Do not hurry applying normal CLIMB thrust after passing through 3000' AGL. Maintain the same pitch attitude used during the QUIET EPR segment. This will normally be an optimum attitude for accelerating to 250K. When 250K is reached, the nose will then have to be raised slightly to maintain 250.

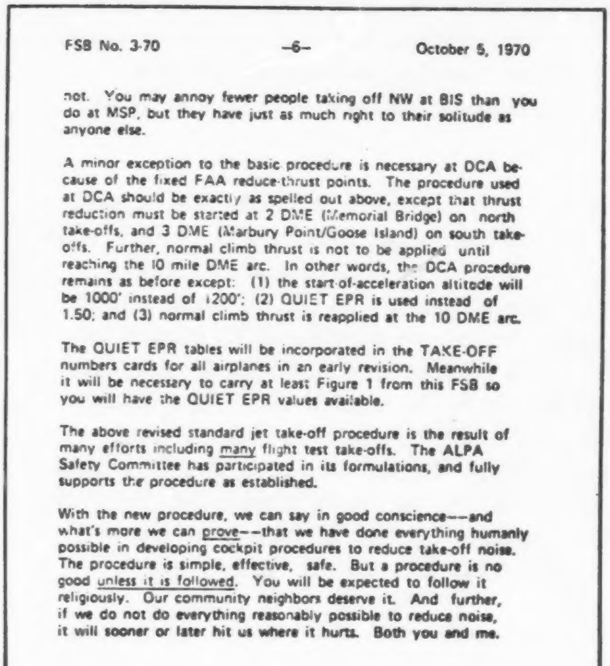
When The QUIET EPR Take-Off Procedure Is To Be Used

The above procedure, thrust reduction and all, is the standard NWA take-off procedure for all normal jet take-offs, regardless of location. The only allowable exceptions are as follows.

The QUIET EPR segment shall be skipped only:

1. When compliance with a SID or other traffic clearance requires a higher climb rate (this will be rare).
2. If significant wind shear or turbulence is forecast, expected, or encountered below 3000'.
3. When taking off at night or under reduced ceiling and visibility conditions at mountain stations such as BTM, MSO, HLN, or BZN, or taking off east at HNL or ANC, etc. When there is any doubt about terrain or obstruction clearance, the QUIET EPR segment should be skipped.

Now the above are not to be stretched into "escape clauses" letting you skip the QUIET EPR segment at other times. It of course should be skipped at any time other conditions (e.g., emergency) make it desirable to do so. But other than the above, such cases should be rare. The procedure is specifically applicable to all stations whether there appears to be a local noise problem or



FSB No. 3-70 -6- October 5, 1970

not. You may annoy fewer people taking off NW at BIS than you do at MSP, but they have just as much right to their solitude as anyone else.

A minor exception to the basic procedure is necessary at DCA because of the fixed FAA reduce-thrust points. The procedure used at DCA should be exactly as spelled out above, except that thrust reduction must be started at 2 DME (Memorial Bridge) on north take-offs, and 3 DME (Marbury Point/Goose Island) on south take-offs. Further, normal climb thrust is not to be applied until reaching the 10 mile DME arc. In other words, the DCA procedure remains as before except: (1) the start-of-acceleration altitude will be 1000' instead of 1200'; (2) QUIET EPR is used instead of 1.50; and (3) normal climb thrust is reapplied at the 10 DME arc.

The QUIET EPR tables will be incorporated in the TAKE-OFF numbers cards for all airplanes in an early revision. Meanwhile it will be necessary to carry at least Figure 1 from this FSB so you will have the QUIET EPR values available.

The above revised standard jet take-off procedure is the result of many efforts including many flight test take-offs. The ALPA Safety Committee has participated in its formulations, and fully supports the procedure as established.

With the new procedure, we can say in good conscience––and what's more we can prove––that we have done everything humanly possible in developing cockpit procedures to reduce take-off noise. The procedure is simple, effective, safe. But a procedure is no good unless it is followed. You will be expected to follow it religiously. Our community neighbors deserve it. And further, if we do not do everything reasonably possible to reduce noise, it will sooner or later hit us where it hurts. Both you and me.

Paul A. Soderlind, Director
Flight Operations-Technical

PAS/mms

Attachment - Figure 1

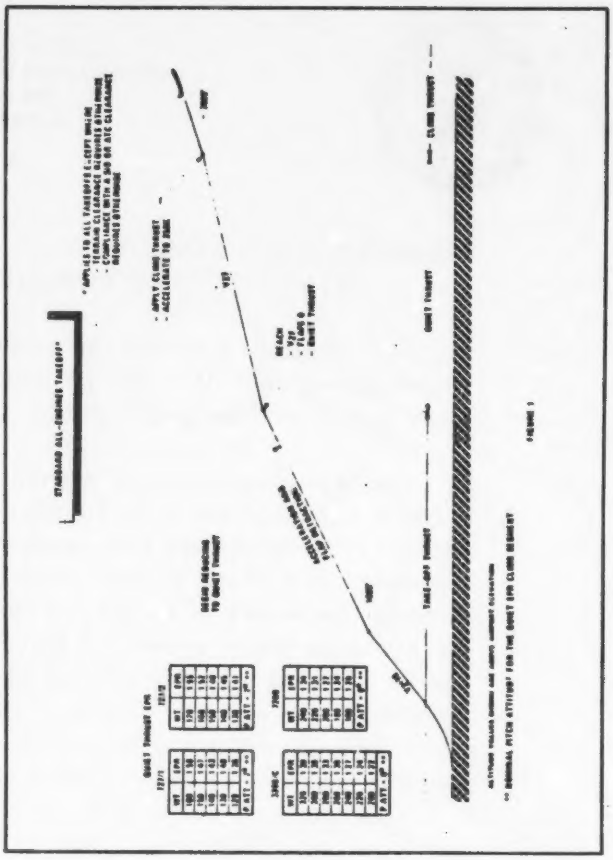

STANDARD ALL-ENGINES TAKEOFF*
* APPLIES TO ALL TAKEOFFS EXCEPT WHEN:
- TERRAIN CLEARANCE REQUIRES OTHERWISE
- COMPLIANCE WITH A SID OR ATC CLEARANCE REQUIRES OTHERWISE
3000'
- APPLY CLIMB THRUST
- ACCELERATE TO 250K
REACH
- VZF
- FLAPS 0
- QUIET THRUST
BEGIN REDUCING TO QUIET THRUST
ACCELERATION AND FLAP RETRACTION
1000'
TAKE-OFF THRUST
QUIET THRUST
CLIMB THRUST
QUIET THRUST EPR
727/1
727/2
720B
WT
EPR
P ATT - 8° **
ALTITUDE VALUES SHOWN ARE ABOVE AIRPORT ELEVATION
** NOMINAL PITCH ATTITUDE FOR THE QUIET EPR CLIMB SEGMENT

FIGURE 1

DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
200 STOVALL STREET
ALEXANDRIA, VA 22332

3 May 1973

MEMORANDUM FOR DR. S. J. NETHERY, CHAIRMAN OF THE NOISE STUDY GROUP FOR MILITARY AIRCRAFT

1. In compliance with your request to submit my thoughts on the land planning aspects of noise pollution around military airports, the following very rough outline is provided.

2. We have, as I see it, a three part problem. First, we must determine some uniform exposure criteria for noise and some uniform compatible uses of land that are consistent with this uniform exposure criteria. Secondly, we must have a uniform application of this criteria in determining the zones of excess noise exposure and appropriate compatible uses within these zones. I think that the first of the problems outlined above is being rapidly solved by empirical methods and should be available in the very near future. The second problem is not so far along in solution but neither is it a difficult one to overcome. Both the Air Force and the Navy have developed a technique for study of the noise problem as it concerns land use which pretty much follows the sequence of a noise study, a safety study, a plot of the various defined noise and safety zones and then within this plot the logical and reasonable development of a rationale for compatible uses to suit the unique situation to be found at each different air base.

3. I would like to devote most of my thoughts therefore to the third and missing vital link which is a set of recognized legal machinery which will force the zoning issue and implement the uniform application of noise criteria. We have given this considerable thought and there does appear to be a logical and rational way to insure implementation of compatible use zone studies once they are completed. First of all, I think that this could reasonably and logically be a part of any National Land Planning Act passed by Congress and could be cast in the role of a model land planning procedure which the states are encouraged to use under the Land Planning Act. The funding requirement which would be a part of the technique could be a continuing part of the National Land Planning Act and could flow from authorizations and appropriations on an annual basis.

4. Here is the way that I would cast a scenario for such a model airport land planning criteria. The first step would be to prepare a noise pollution abatement study under a set of uniform exposure criteria and applications which could be spelled out in the National Land Planning Act

and which would no doubt be very similar to the types of studies now being initiated by the Air Force and Navy. Once this prescribed study was completed, it would then be filed mandatorily with the local planning organization and the local zoning organization. These elements would be required to give public notice and have public hearings on all aspects of this study for the expressed purpose of determining the technical adequacy of the study. In other words, the study would not be open to criticism or change from the standpoint of whether or not a compatible use requirement existed but would be subjected to very critical review as to the proper application of exposure criteria and compatible use criteria to this particular situation. After these public hearings were completed and as in the case of an Environmental Impact Statement, there would be a required waiting period to insure all interested parties the opportunity for written input after which the zoning board would approve of the plan as developed or as modified on the basis of evidence as presented and at this point under the law implement a mandatory rezoning of all lands affected by the study. Now this would certainly not change lands on which non-compatible uses have already been constructed. It would, however, stop any further rezoning of these lands at some future date into some other non-compatible use and it certainly will hold encroachment in its tracks at whatever degree of non-compatible development existed at the time of the mandatory rezoning. At this point in the legal manipulations, it is painfully obvious that many land owners in the affected areas would be damaged and should have some recourse under the law to obtain satisfaction for these damages. This could be provided for under the National Land Planning model law with either the establishment of an impartial commission to hear complaints and determine equitable settlements or by tasking under the law an existing State Court system to hear the cases and determine equitable settlements. The settlements would then, of course, be paid out of authorizations and appropriations available annually under the National Land Planning Act.

5. It is recognized that this is a precedent setting approach, however, it is patterned after the series of things which happens in a situation where we make our study and present it to a local zoning board who in turn rezone on this basis. The aggrieved and all injured land owners then drag us into court and sue on the basis of inverse condemnation and if they win, a settlement is made and we then own rights on the land and they have been duly compensated and this is where we wanted to get in the first place. What I am proposing is a means to formalize these steps.

6. In addition, I am attaching a paper prepared by our planners working in this arena which will provide you with additional background data which

you may or may not already have. The charts showing the interrelationship of the various Governmental bodies to the land use problem are of considerable interest.

Respectfully,

R. E. ANDERSON

Attachment

Land Use Policy and Planning In the Vicinity of Military Air Installations
(Air Installation Compatible Use Zone)

I. Background.

a. Toward the later parts of the 1950's and extending into the 1960's the detrimental effects of urban encroachment on military air installations became increasingly evident. There have been repeated warnings. There have been attempts at assisting the local community when possible, in developing a rational zoning system. There have been persistent efforts by the Armed Services to improve air installations/community relations. Large amounts of public information concerne~~d wit~~h the hazards and noise associated with military aircraft operations have been disseminated. To date, little heed has been taken, especially with regard to residential developing. On some installations there has been a deleterious effect on operations by curtailment of flight operations, changes in traffic patterns and revisions to operational procedures. Mission degradation has been the result of these factors.

b. Although the U.S. Congress expressed interest in the regulation of land use in the vicinity of airports, including the encouragement of local authorities to utilize zoning powers, via a

1964 amendment to the Federal Airport Act, this was not applicable to Military Air Installation. Land regulation in the vicinity of military air installations can be effected via the direct acquisition of property or through various other methods. Encompassed in land regulation are police powers which provides a legal basis for the enactment of building and housing codes and zoning laws. Under police powers, therefore, is the power vested in a State to, enter alia, promote the public welfare. In varying degrees, the States have delegated this power to local jurisdictions. It should be noted that police powers contain the right to regulate an individual's rights in property, and would be done so without compensation to the individual, if its enactment would be considered as reasonable and fairly related to the public health, safety, and the general welfare (within the constraints indicated local jurisdictions would therefore have the authority to issue zoning regulations). While zoning is utilized primarily as a preventive mechanization, it has little value in changing uses in already developed areas.

c. There have been numerous instances where individuals and/or organized groups of citizens have complained about the noise being generated by aircraft located at military installations. Complaints have ranged from telephone calls at one end of the spectrum to organized legal action at the other. Analysis of these actions indicate that aircraft noise effects the local community by, enter alia, disruption of sleep and rest, interruption of telephone calls and conversation, and interference with television reception. Other major factors that have a decided influence on community response to military aircraft noise is the normal community background noise level (varying from the relative quiet of a residential area to the clamor of an industrial area), the frequency of flights, the duration of the noise, the time frame and season of the year. Studies have been conducted which provide substantial evidence that a relationship does exist between noise levels and interference with speech and loss of hearing. Studies are continuing on the effects on sleep and possible physiological impairments.

II. Current Status.

a. During the 1940-44 time frame a model Zoning Enabling Act was drafted. The model act was designed to grant local communities the authority to adjust airport zoning regulations applicable only for airport hazard areas. The 1944 model act does not, however, directly grant local communities the right to zone for land use compatible with aircraft noise, or in fact, to preclude such compatible land uses.

b. As expressed in a recent HUD Publication "The most important program for achieving compatibility between aircraft noise and the environment are the comprehensive Planning Assistance Program of the Department of Housing and Urban Development and the Airport Planning Grant Program of the Federal Aviation Administration." Regretably these programs have had little, if any, effect on resolving problems around military air installations.

c. To date, the only instrument, and at this point in time it is only in the proposal state, that would initiate some type of Department of Defense policy for providing for the development of a compatible use program for military air installations, is DODINST 4165.XX, Air Installations Compatible Use Zones.

III. Comments.

a. Every military aircraft that flies makes noise; however, flying with larger, more powerful, and faster military aircraft is considered absolutely essential to the defense posture of the United States. Therefore, it is essential that communities located contigious to military air installations understand that noise eminating from military aircraft must be faced up to.

b. From a total systems approach to the problem of aircraft noise, the importance of determining the type of air operations rests with the fact that a significant decrease in noise level would occur at that where a takeoff thrust reduction is made, whereas all other changes in noise level would occur more gradually. This may suggest that a logical point (the thrust reduction) does exist for establishment of a dividing line in any future compatible land use and/or zone planning, since a step from very high takeoff power noise levels to lower climb power noise levels occurs.

IV. Conclusion.

a. Modern society has to come to recognize the social and economic benefits of military aviation operations as essential to the defense posture of the United States.

b. Military aircraft operations do adversely affect the environment around air installations with noise and soot, inflicting social and, sometimes, economic costs on communities near these installations.

c. That noise exposure should be reduced to the practical minimum because it both degrades our environment and inhibits the development of the community at large.

d. Compatible land use, coupled with the development of complementary zoning and building codes,. appears to be the most promising means of reducing peoples' exposure to noise around military air installations. Military air installations are places of work for a large number of civilians living in the area. Land values adjacent to these installations have risen tremendously. Both of these factors, plus the growing needs of industry and studies indicating that in many cases construction of family residences is a tax drain on the community (revenue needs for local government would be much greater with more intensive residential development), suggest that holding lands for agriculture, industrial and commercial buildings would represent a more productive use of land near military air installations than would housing developments.

e. In light of the WHO definition, aircraft noises radiating into communities in the vicinity of military air installations can be considered a potentially harmful to health for a number of reasons noted herein. Therefore, public powers vested in a State to promote the public welfare would be applicable to the situation and therefore the right to regulate an individual's property would be inherent in this power. Present data would seem to clearly support subjective and experimental reports that auditory stimuli, including jet aircraft noise, can be reflected in an individual's sleep pattern. Further, present results indicate that these effects can outlast the stimuli. The facts tend to indicate that an individual can be temporarily affected and this effect is detrimental to, at least, certain performances. The World Health Organization (WHO) defin~~it~~es health as a state of complete physical, mental and social well-being--not merely the absence of disease or infirmity.

f. Noise problem eminating from military aircraft can be broken into three component parts:

(1) The source, in this case, military aircraft;

(2) The path along which the noise travels, and finally;

(3) The receiver, in this case, the human ear.

It should be noted that although the noise problem is composed of three separate and distinct components they must be considered as an indivisable system in the development of a balanced, overall program for resolution. In this regard possible aircraft noise abatement strategies (tasks and strategies) have been provided in Table I.

g. There is a definite need to establish noise zones based upon an evaluation of current and/or expected future noise environment arising from flight operations at military air installations. The daily noise exposure should be calculated by the Noise Exposure

Forecast method or corresponding equivalent, or by any other system to be recommended by the Environmental Protection Agency, as a preferred method for calculating noise exposure in the United States. There is a tolerance on the accuracy of NEF contour lines but, they generally portray a fairly reliable montage of gradually decreasing noise exposure as they are crossed going away from the runway. A number of significant factors may be present which require adjustments to or selection of different contours in the development of compatible land use planning and in the development and application of building code requirements. The following could be the definitions of five distinct noise zone boundaries:

(1) Insensitive Noise Zone--an insensitive noise zone is hereby established as that area that commences at the outermost boundary of the military air installation and extends outward thereof to a contour indicating an equal noise exposure forecast of 40 as calculated by the Noise Exposure Forecast rating method.

(2) Moderately Insensitive Noise Zone--a moderately insensitive noise zone is hereby established as an area that commences at a contour indicating equal noise exposure of 40 and extends beyond the air installation to a contour indicating equal noise exposure of 35 as calculated by the Noise Exposure Forecast Method.

(3) Moderately Sensitive Noise Zone--a moderately sensitive noise zone is hereby established as an area that commences at a contour indicating equal noise exposure of 35 and extends outward beyond the air installation to a contour indicating equal noise exposure of 30 as calculated by the Noise Exposure Forecast Method.

(4) Sensitive Noise Zone--a sensitive noise zone is hereby established as an area that commences at a contour indicating equal noise exposure of 30 and extends outward beyond the air installation to a contour indicating equal noise exposure of 25 as calculated by the Noise Exposure Forecast method.

(5) Very Sensitive Noise Zone--a very sensitive noise zone is hereby established as an area that commences at a contour indicating equal noise exposure of 25 as calculated by the Noise Exposure Forecast method and extends outward beyond the air installation to encompass all land with lower noise exposure than that of the specified contour.

h. The established noise zone boundaries, in conjunction with a proposed Air Installation Zoning Map would be reviewed by the appropriate authority and revised as necessary to accomplish the aims of the still to be enacted "Land Use Policy and Planning Assistance Act of 1973 (H. R. 2942) and DOD Instruction 4165.XX, Air Installation Compatible Use Zone. A review of the documents in question should take into account the following, as well as such other additional factors as the municipal authority deems desirable.

(1) Forecasts of operations for the following five and ten year period provided by the military air installations.

(2) Noise exposure maps prepared with cooperation of the military air installation.

(3) Technological changes occurring since the previous review which are likely to result in changes in aircraft types, modes of operations or noise output.

(4) Measurements of the noise environment based upon information obtained by any noise monitoring system maintained by the municipality and the military air installation.

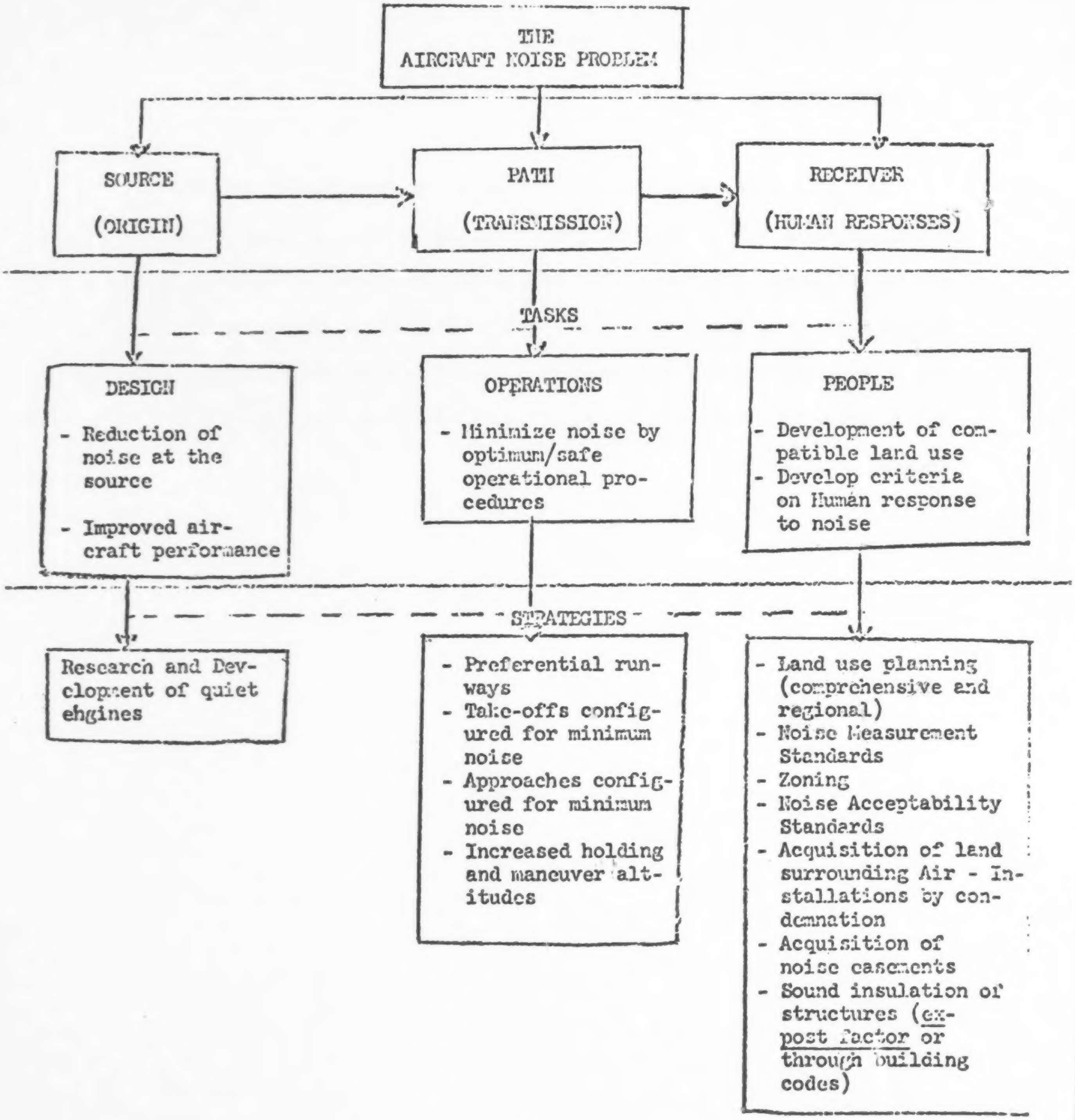
i. Notwithstanding, the provisions of DODINST 4165.XX, AICUZ, the activities and land uses that should be permitted or restricted in the five noise zones indicated above should be as provided in Table 2. The Noise Land Reduction values contained in the table would be the minimum noise level reductions required for all occupied rooms in enclosed facilities as the land in question. In addition, no use could be made of land within any zone, in such a manner as to create electrical interference with radio communication between the military air installation and aircraft, make it difficult for flyers to distinguish between airport lights and others, result in glare in the eyes of flyers using the airport, impair visibility in the vicinity of the air installation or otherwise endanger landing, taking off, or maneuvering of aircraft.

It is evident that the military air installation/community compatibility or rather incompatibility problem is the final result of interrelating actions between two separate and distinct sets of economic agents. The first, are the factors which created the existing utilization of land in the vicinity of the installation. The second are those agents which established the level of flight activity. It has already been established that residential and related land uses in the vicinity of an air installation are incompatible with high levels of flight operations at the installation. Since it must be assumed that there is a need to develop knowledge of the extent of air installation/community, some measure should be developed to gauge the situation of various air installations. Accordingly, an approach should be developed containing an index of incompatible use in the vicinity of the installation (as for example, a land use index, noise pollution potential index and encroachment potential index--along the lines presented by Back and Sterling as a paper 'Classification of Airport Environs by Airport/Community Land Use Compatibility", dated 28 January 1972).

j. Since as Charles C. Schempeler ("Airport Planning and the Environment, Airport World, IV, March 1971) points out "there is a multiplicity of private decision-making entities, each making decisions on the basis of self-interest" and from these conflicts evolves a reciprocally destructive interrelationship where all relevant factors are not considered by a highly fragmented decision-making apparatus. It is therefore necessary that a ~~certified~~ UNIFIED centrally guided operation be developed that can provide the guidance, backed by sufficient funding, to motivate the nation as a whole to resolve the problem of compatible land use planning in the vicinity of military air installations. The passage of federal legislation, as a part of an overall land use policy would be appropriate.

4. Recommendation

H.R. Bill 2942 should be modified so as to specifically provide for the development of land use compatibility in the vicinity of military air installations. Further, that additional functions be assigned to the National Advisory Board on Land Use Policy (sec 203), that of directing and management of the development of a "Model Airport Noise Zoning Ordinance and Building Code" to be proposed for utilization by the States And Federal Government.


THE AIRCRAFT NOISE PROBLEM
SOURCE (ORIGIN)
PATH (TRANSMISSION)
RECEIVER (HUMAN RESPONSES)
TASKS
DESIGN
- Reduction of noise at the source
- Improved aircraft performance
OPERATIONS
- Minimize noise by optimum/safe operational procedures
PEOPLE
- Development of compatible land use
- Develop criteria on Human response to noise
STRATEGIES
Research and Development of quiet engines
- Preferential runways
- Take-offs configured for minimum noise
- Approaches configured for minimum noise
- Increased holding and maneuver altitudes
- Land use planning (comprehensive and regional)
- Noise Measurement Standards
- Zoning
- Noise Acceptability Standards
- Acquisition of land surrounding Air - Installations by condemnation
- Acquisition of noise easements
- Sound insulation of structures (*ex-post factor* or through building codes)

Source: Modified version of chart appearing in James F. Woodall, "FAA Noise Suppression Program," in Jet Aircraft Noise Panel, *Alleviation of Jet Aircraft Noise Near Airports: A Report*, Washington, D.C., Office of Science and Technology, Executive Office of the President, 1966, p. 43f.

AIRCRAFT NOISE ABATEMENT STRATAGIES

TABLE II

PERMITTED AND RESTRICTED LAND USES AND MINIMUM NOISE LEVEL REDUCTION REQUIREMENTS FOR STRUCTURES

ACTIVITIES AND LAND USES*	LAND USE NOISE ZONES				
	VERY SENSITIVE (NEF < 25)	SENSITIVE (NEF25-30)	MODERATELY SENSITIVE NEF30-35)	MODERATELY INSENSITIVE (NEF35-40)	INSENSITIVE (NEF > 40)
Residential (1)	Permitted	Permitted	Permitted with NLR 25	Not Allowed	Not Allowed
Residential (2), Educational and Institutional (3)	Permitted	Permitted	Permitted with NLR 25	Permitted with NLR 30	Not Allowed
Auditoriums, Concert Halls	Permitted	Permitted with NLF 30	Permitted with NLF 35	Not Allowed	Not Allowed
Outdoor Amphitheaters, Music Shells	Permitted	Not Allowed	Not Allowed	Not Allowed	Not Allowed
Offices, Personal, Business and Proffessional Services, Commercial-Retail Movie Theaters, Restaurants (4)	Permitted	Permitted	Permitted	Permitted with NLR 25	Permitted with NLR30
Transient Lodging-Hotels, Motels	Permitted	Permitted	Permitted with NLR 25	Permitted with NLR 30	Permitted with NLR 35
Sports Arenas, Outdoor Spectator Sports	Permitted	Permitted	Permitted	Not Allowed	Not Allowed
Playgrounds, Neighborhood Parks	Permitted	Permitted	Permitted	Not Allowed	Not Allowed
Golf Courses, Driving Ranges, Water-Recreation, Cemeteries, (5)	Permitted	Permitted	Permitted	Permitted	Permitted
Commercial-Wholesale and Selected Retail, Industrial/Manufacturing, Transportation Communication and Utilities (6)	Permitted	Permitted	Permitted	Permitted	Permitted
Animal-related services (7)	Permitted	Permitted	Permitted	Permitted	Not Allowed
Agricultural (8)	Permitted	Permitted	Permitted	Permitted	Permitted

---

*See accompanying notes for expanded list of activities and land uses.

NOTES (Accompanying Table 2)

(1) Single family detached, duplex, mobile home parks.

(2) Triplex, fourplex, apartment houses, multi-family dwellings, rooming houses, boarding houses, old persons homes, sorority and fraternity houses, dormatories, boarding schools, convalescent homes.

(3) School classrooms, libraries, churches, hospitals

(4) Professional and financial offices, banks, savings and loan associations, mortgage bankers, insurance offices, real estate offices, architects, engineers, attorneys at law, decorators, medical and dental clinics and labs, funeral homes and mortuaries, retail stores, clothing stores, department stores, food and dairy markets, cafes, restaurants (enclosed and drive-in), cafeterias, barber shops, beauty shops, new and use care sales, country clubs.

(5) Includes swimming pools, shooting ranges, miniature golf courses

(6) Includes

Auto salvage & wrecking yards
Industrial metal and waste salvage yards
Manufacturing facilities
Gasoline service stations
Ambulance services
Automotive repair garages
Public storage garages
Taxi dispatch offices
Automobile washing stations
Lumber yards
Warehousing
Motor freight terminals
Railway passenger and freight stations
Airport services

(7) Includes animal grooming services, dog kennels veterinarians and veterinarian hospitals.

(8) Includes farms, orchards, nurseries, greenhouses.

ELEMENTS OF CONTROL OVER AIRCRAFT NOISE AND LAND USE PLANNING	PROPOSED ORGANIZATIONS INVOLVED IN MILITARY AIRCRAFT NOISE ABATEMENT POLICIES AND DECISIONS												
	CONGRESS	EPA	FAA	HUD	DOD	STATE LEGIS. AND DEP'TS	METRO COUNCIL	AIR INSTAL/ COMM. COUNCIL	MUNICIPAL GOVT'S	BUSINESS	LOCAL ZONING	TECHNICAL EXPERTS	COMMUNITY GROUPS
LAND USE PLANNING/POLICY	+	•	•	•	•	•						•	
NOISE MEASUREMENTS STDS.		+	•		•	•						•	•
NOISE ACCEPTABILITY CRITERIA		+	•	•	•	•						•	•
AIRCRAFT TYPES					+								
AIR INSTALLATIONS:													
MASTER PLANNING (VICINITY OF)					•	•	•	•	+	•	•	•	•
OPERATIONS PLANNING			•		+	•	•	•	•	•	•	•	•
FLIGHT PATHS			+		+	•	•	•	•	•	•	•	•
ZONING		•	•	•	•	•	•	•	+	•	•	•	•
BUILDING CODES (SOUNDPROOF)		•		•	•	•	•	•	+	•	•	•	•

+ = DECISION-MAKING AUTHORITY
• = PARTICIPANTS IN THE DECISION-MAKING

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

JUN 20 1973

Dr. Sidney Netherey, Chairman
Task Group 6, Aircraft/Airport Noise
Report Study
Environmental Protection Agency
Crystal Mall Building No. 2, Rm. 1107
1921 Jefferson Davis Highway
Arlington, Virginia 22202

Dear Dr. Netherey:

As a participant in the Task Group 6 study of Military Aspects, we would like to take this opportunity to submit information for inclusion in the Group's final report.

1. Sonic Booms. Sonic booms caused by military aircraft have been a matter of grave concern to the National Park Service for more than ten years. Sonic booms have inflicted damage upon natural and cultural features in a number of areas within the National Park System. Among some of the noteworthy effects of sonic booms have been:

a. Precipitated rock slide which demolished prehistoric Indian ruin, Canyon de Chelly National Monument, Arizona. 1966.

b. Caused geologic formation to fracture and slide, Bryce Canyon National Park, Utah. 1966.

c. Caused large rock to fall onto trail, Yosemite National Park, California. 1971.

d. Frightened sooty tern colony with resultant heavy mortality to incubating eggs, Fort Jefferson National Monument, Florida. 1969.

e. Caused roof damage to prehistoric Indian ruin, Navaho National Monument, Arizona. 1971.

f. Widened crack in wall of fort ruins, Fort Union National Monument, New Mexico. 1971.

g. Caused large rock slide onto road, Mesa Verde National Park, Colorado. 1968.

h. Damaged wall to restored ruins, Fort Laramie National Historic Site, Wyoming. 1971.

Aside from the physical damage to protected features, sonic booms also cause considerable annoyance to visitors who in seeking a wilderness experience come to the national parks for tranquility and escape from pressures of the modern world. Numerous letters of complaint have been sent to park officials noting the obvious concern of visitors against this disturbance.

In late 1971 a conference was held with representatives of the Air Force to discuss ways of diminishing the unacceptable and injurious effects of sonic booms over national parks and monuments. At that time the Air Force advised that a number of changes were being made in the flight patterns of the SB-71, the craft which accounted for over 70 percent of supersonic activity in the US. The Air Force requested and was furnished a list of biologically and geologically sensitive areas for the purpose of avoiding or minimizing sonic overflights where possible. This list included:

Florida	Everglades National Park Fort Jefferson National Monument
New Mexico	Chaco Canyon National Monument Aztec Ruin National Monument Gran Quivera National Monument
Arizona	Canyon de Chelly National Monument Wupatki National Monument Navaho National Monument
Utah	Rainbow Bridge National Monument Natural Bridges National Monument Arches National Monument Bryce Canyon National Monument
California	Death Valley National Monument
Colorado	Mesa Verde National Park

Additional yeoman's service by the Air Force is recognized when they published USAF Regulation 55-34 on February 14, 1972, which prohibits overflights of all national parks unless a specific waiver is requested from Headquarters USAF. As Attachment No. 1 indicates, although not all records are available the general impression is that an overall reduction of recorded sonic booms of thirty to fifty percent has occurred since re-routing of SB-71 overflights and implementation of AF Regulation 55-34.

However, while there has been a marked diminution of sonic boom activity, there appears to be areas of concern where further discussions with the Air Force might prove fruitful. Death Valley National Monument, Nevada and California, continues to report an unacceptable rate of supersonic activity.

Window damage in public buildings still occurs and while there is no positive evidence, it is suspected that the recent collaspe of several mine tunnels is attributable to sonic boom disturbance. Due to the vast number of mine tunnels existing in Death Valley there is a genuine concern for park visitor safety.

2. Low-Level Flights. Another area of military activity which is another concern to the National Park Service is low-level flight. In this instance military aircraft intrude on the tranquility of national parks more so than causing physical damage to natural and cultural features. Such areas as Death Valley National Monument and Grand Canyon National Park are used extensively as sites for training missions and maneuvers. These and other areas due to their remoteness and unique terrain setting offer ideal training environments for low-level activities. However, this military mission is in direct conflict with that of the National Park Service's attempt to maintain natural conditions, ecologically and environmentally, and including sight and sound. In addition there is an obvious safety hazard to the park visitor, civilian and official aircraft, and wildlife of the area as a result of this activity.

Death Valley National Monument has another unique feature (the floor of Death Valley lies more than 280 feet below sea level) which appears attractive to some military pilots. It is considered to be a novel accomplishment by both Air Force and Navy pilots to join the ranks of "below-sea-level club" in both sub- and supersonic aircraft. Reports of military aircraft flying as low as 50 feet above the salt pan are not uncommon. It is inconceivable that this sort of activity serves any military purpose and any reduction or elimination would compromise operational flexibility.

Recently, some areas, notably Death Valley National Monument, Grand Canyon National Park and Lake Mead National Recreation Area are reporting an increase in the number of sonic booms and low-flying aircraft since January 1973. Perhaps this increase is related in some way to the decrease in Vietnam activities and represents a return to more stateside operations.

Contacts by park officials with nearby military officials in response to individual complaints about sonic booms or low-level flights have been cordial and some progress has been made in certain instances. Infractions continue to occur, however. The National Park Service recognizes the military's obligation of providing and insuring the country's continued national security and is convinced that an effective solution can be found without compromising both agencies' duties. We look forward to working closely with the military in this matter of further eliminating or reducing certain objectionable activities.

Sincerely,

Neal G Guse, Jr

Neal G. Guse, Jr.

Record of Sonic Booms
For Selected National Park Areas

Total Monthly Sonic Booms Recorded

Name of Park	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Southwest Region														
Canyon de Chelly NM	1969	8	4	0	0	6	9	11	4	2	4	2	1	51
Arizona	1972	0	0	0	0	0	0	0	0	0	0	0	0	0
Carlsbad Caverns NP	1969			Records not available for 1969										
New Mexico	197	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Union NM	1969			Records not available for 1969										
New Mexico	1972	0	0	0	0	0	0	0	0	0	0	0	0	0
Gran Quivira NM	1969			Records not available for 1969										
New Mexico	1972	0	1	0	2	0	0	0	0	2	0	0	0	5
Navaho NM	1969	2	8	4	6	1	1	3	0	0	0	0	0	25
Arizona	1972	0	1	0	1	2	3	0	2	0	0	1	0	10
Western Region														
Cabrillo NM	1969			Records not available for 1969										
California	1972	3	14	13	5	17	62	10	18	12	14	6	5	179
Death Valley NM	1969	31	19	26	21	23	13	25	10	16	17	14	40	255
California	1972	35	13	21	1	1	2	37	14	7	8	4	11	154
Grand Canyon NP	1969	0	0	0	0	0	0	0	0	2	0	3	3	10
Arizona	1972	1	1	0	0	0	0	0	0	0	0	1	3	6
Lake Mead NRA	1969			Records not available for 1969										
Ariz. - Nev.	1972	1	14	16	13	15	7	11	50	9	0	10	4	150
Petrified Forest NP	1969	0	0	0	0	0	0	12	14	7	11	7	4	55
Arizona	1972	4	14	5	3	0	0	0	0	1	0	1	0	28
Yosemite NP	1969					Records not available for 1969								
California	1972	0	0	0	0	0	0	0	0	0	0	0	0	0